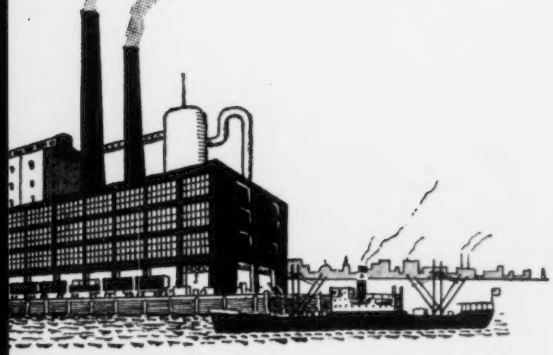
Vol. 32 . No. 2
April 1956

ECONOMIC GEOGRAPHY



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The editors and the University assume no responsibility for statements and opinions expressed by contributors

ECONOMIC GEOGRAPHY

Editorial and Business Offices: 950 Main Street, Worcester, Mass.

Published Quarterly at
Commonwealth Press, 44 Portland Street, Worcester, Mass.

PRICE, $1.75 THE CURRENT NUMBER SIX DOLLARS A YEAR
(except for charter subscribers)

Entered as second class matter at the Post Office at Worcester, Mass.
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ECONOMIC GEOGRAPHY

VOL. 32 APRIL, 1956 NO. 2

SUBSTANDARD URBAN HOUSING IN UNITED STATES: A QUANTITATIVE ANALYSIS

George W. Hartman and John C. Hook

Dr. Hartman, Associate Professor of Geography at the State University of Iowa, has specialized in urban geography. Dr. Hook, his associate in the present study, is Instructor in Geography, Dartmouth College.

IT has been established by American geographers today that the urban geographer concerns himself with a study of the spatial characteristics of urban phenomena.[1] Geographic studies of this type usually involve the use of two separate but related types of analysis. The first type deals primarily with the description of the areal arrangement of individual phenomenon; the second involves a comparative study of the similarities or dissimilarities of the individual distributions. The latter is by nature the more complex since it involves analysis of two or more distributions that may or may not be associated. The most common comparative technique of study of the past has been the use of visual comparison of a series of maps, perhaps as translucent overlays, each of which shows only the distribution of one type of data. More recently, however, a second technique has been gaining favor—that of the use of certain statistical procedures that are applicable to testing spatial associations.

Most urban phenomena in the modern world are exceedingly complex in their associations and interrelationships, so that it is necessary for the geographer to limit himself at any one time to an examination of a limited number of variables that have possible associations. The procedural steps in a quantitative investigation under such a limitation at this level of investigation involve the statement of a problem, the formulation of a series of hypotheses to be tested, and the use of established statistical tests to determine the adequacy of the hypotheses as related to the stated problem.

The broad problem to be investigated in the study which follows is concerned with certain geographic considerations of the relative proportion of substandard housing in American cities. More specifically, three questions are posed: (1) what is the nature of the variations in the proportion of substandard housing of the 1262 cities in the United States with populations of 10,000 or more (1950 census)? (2) how are the variations in the proportion of substandard housing areally distributed in the United States? (3) what is the nature of the areal variations of possibly associated phenomena?

[1] H. M. Mayer: "Urban Geography" in *American Geography, Inventory and Prospect*, P. E. James and C. F. Jones, Eds., 1954, p. 143.

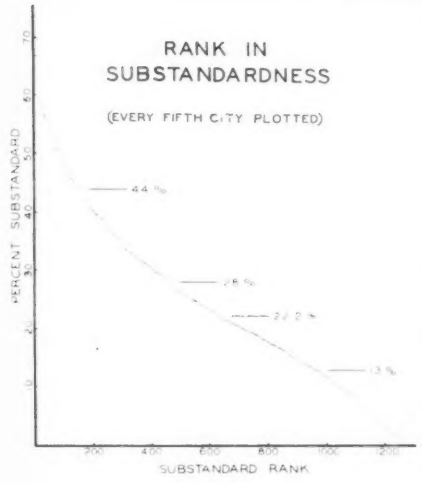

FIG. 1.

"Substandard housing" is a term used by the Public Housing Administration, U.S. Housing and Home Finance Agency (H.H.F.A.), to characterize dwelling units that are deficient in decent safe and sanitary housing facilities, i.e., dwelling units that are below generally accepted minimum standards in the United States. More specifically, the term refers to dwelling units that are either dilapidated or lack basic sanitary amenities.[2] A unit that lacks sanitary facilities is without hot running water or without a flush toilet or without bathing facilities inside the structure for the exclusive use of the occupant family of the dwelling. If the unit is dilapidated, it is considered to have serious structural deficiencies, is run-down or neglected, or is of inadequate original construction, so that it does not provide adequate shelter or protection against the elements or endangers the safety of the occupants. Quantified data are provided by the Bureau of Census which makes it possible to determine the proportion of substandard housing in each of the cities under study. This is accomplished simply by subtracting from 100 the "Per cent of dwelling units with hot running water, with private toilet and bath, and not dilapidated" as given in the U.S. Census of Housing: 1950, Vol. I, Table 1, Parts 2–6.

The Bureau of Census also provides data in the 1950 Census of Housing and Census of Population for a variety of phenomena which have possible associations with substandardness of housing. In this study, all quantified variables considered are taken from housing and population reports of the Census Bureau with the exception of a climatic factor. The source for each variable is indicated in Table III.

SUBSTANDARD HOUSING VARIATIONS OF AMERICAN CITIES

Variations in the proportion of substandard housing in the various cities under study are shown graphically in Figure 1 by ranked array. While this graph does not portray the substandard proportions for all 1262 cities of 10,000 or more population—only the percentage figures for every fifth city have been plotted—the general nature of the variation is clear. The variations range from 0.2 per cent (University Heights, Ohio) to 73.6 per cent (Helena, Arkansas). The median is 22.2 per cent (e.g., Waynesboro, Pa.). The distribution, therefore, is skewed since there are greater variations among cities with substandard percentages above the median than among those below the median. Breaks or trend changes in the slope of the array line are most

[2] See *U.S. Census of Housing: 1950. Special Tabulations for Local Housing Authorities*, Series HC-6. The term substandard is also referred to and defined for 203 urban Real Property surveys conducted between 1934 and 1936 by the Work Projects Administration (Peyton Stapp, *Urban Housing—A Summary of Real Property Inventories*, 1934-36, Division of Social Research, W.P.A., Washington, D.C., 1938).

noticeable at the values of 28 and 44 per cent as indicated on the graph, and also at 7, 13, 35, 51, and 60 percentage points.

AREAL DISTRIBUTION OF SUBSTANDARDNESS

In order to determine the characteristics of areal variation in substandardness, individual percentages for the cities under study were first plotted on a map of the United States. Difficulties in visual comprehension of areal variations in 1262 percentage values as plotted were overcome through generalizations made possible by use of metal pins with colored heads. Since variations in the degree of substandardness of housing appear to fall into eight classes according to noticeable breaks in the ranked array of percentage values as noted previously, pins of a particular color were used separately for each of the following classes: 0.2–6.9, 7.0–12.9, 13.0–27.9, 28.0–34.9, 35.0–43.9, 44.0–50.9, 51.0–59.9, 60.0–73.6.

Inspection of the distribution of the colored pins over the map of the United States indicated that variations in the substandardness of housing have areal differentiation. Cities with the highest per cent of substandardness are concentrated primarily in southeastern United States and along the lower Rio Grande Valley. Cities in most of northeastern United States, in the western two-fifths of the United States, and in peninsular Florida have the lowest percentage of substandardness. Cities in the remainder of the United States have substandardness values that are generally above the median value (22.2 per cent) for all cities in the United States, but they are intermediate between the areas of high or low values as noted earlier.

If the array breaks of 28 and 44 per cents are used as isoplethic values, seven regions of substandardness of housing may be outlined. Figure 2 indicates the distribution of the cities under study. Because of cartographic

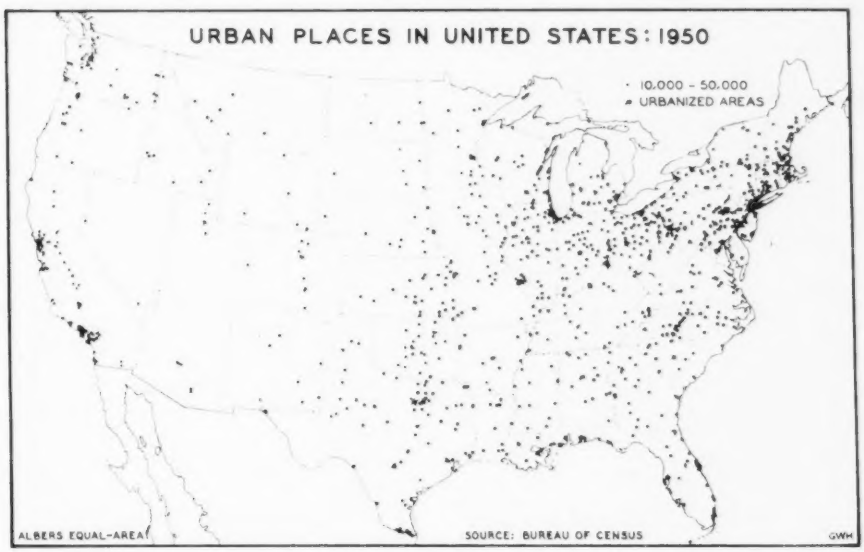

FIG. 2.

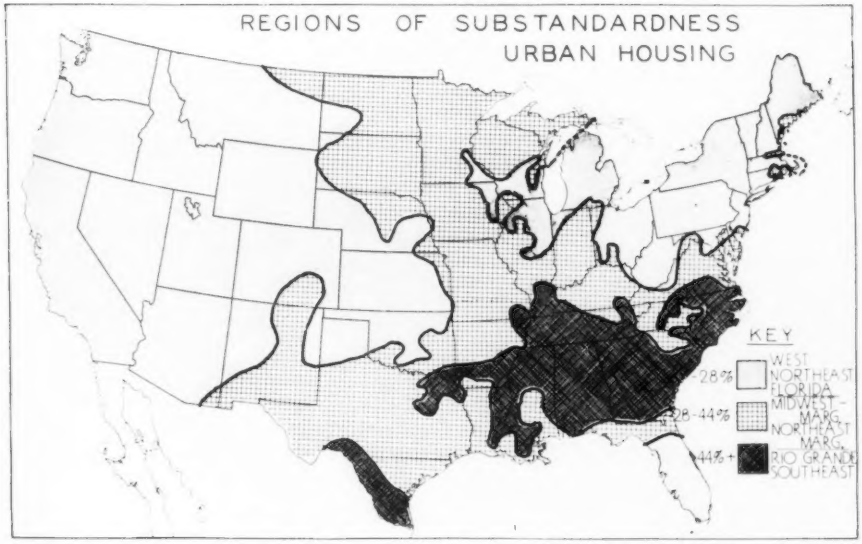
REGIONS OF SUBSTANDARDNESS
URBAN HOUSING
KEY
WEST
NORTHEAST
FLORIDA
MIDWEST - MARG.
NORTHEAST MARG.
RIO GRANDE
SOUTHEAST
28%
28-44%
44%+

FIG. 3.

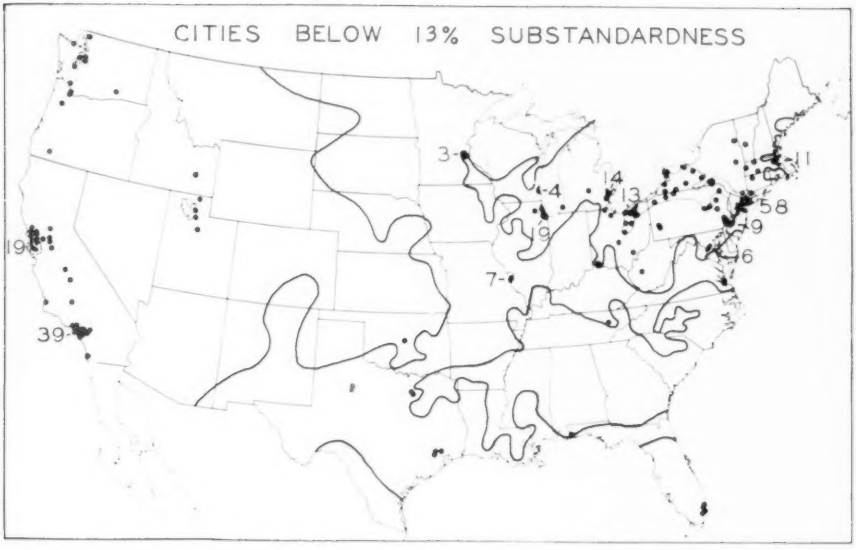
CITIES BELOW 13% SUBSTANDARDNESS
3
4
14
13
11
58
9
16
19
19
7
39

FIG. 4.

difficulties of showing all the cities in certain of the urban complexes on a small-scale map—72 cities in the immediate New York City area, for example—one symbol is used on this map to represent all cities in an urbanized area. Figure 3 shows the location of the seven regions of substandardness of urban housing. These regions of unequal size with their urban housing-quality characteristics are summarized in Table I.

An attempt to isopleth the 305 cities with substandardness values of less than 13 per cent was not successful. Eighty per cent of these cities are located within the large urbanized areas of the United States as "dependent" urban places. As Figure 4 indicates, these cities with low substandardness values are concentrated in the urbanized areas of Boston, New York, Philadelphia, Cleveland, Detroit, Chicago, St. Louis, San Francisco and Los Angeles. Isoplething is possible in only one area within the Northeast Region. This area, as outlined in Figure 4, is an elongated one extending from Cleveland to Buffalo to New York City and Philadelphia. Although it contains almost 36 per cent of the 305 cities involved, it was decided not to consider it as a separate or eighth region. The decision was based upon the fact that the area is made up primarily of Lower Great Lakes cities and Eastern Seaboard cities concentrated around New York and Philadelphia. The narrow corridor which joins these two groups of cities passes through upper Pennsylvania and southeast central New York where there are no cities of 10,000 or more population (compare Fig. 4 with Fig. 2).

Cities that do not conform to the substandardness characteristics of the region in which they are located are represented in Figure 5—by a plus sign if a city's substandardness value is above the maximum value of its region, or by a minus sign if it is below the minimum value. In addition to the nonconforming cities, ten other cities appear as "erratics" on this map in order to avoid separating the cities composing an urban complex into two regions. All cities in an urban complex therefore are considered as being members of the same region according to the substandardness value of the total complex. Urbanized areas involved in this decision are Cincinnati, Mobile, New Orleans, Omaha, and Pensacola. The following combinations of cities, too small to be counted by the Census Bureau as urbanized areas, also were placed in the appropriate region according to a combined substandardness value for both cities: Lafayette and West Lafayette, Indiana; Mishawaka and South Bend, Indiana; Monroe and West Monroe, Louisiana; and Brandon-Judson and Greenville, South Carolina. Altogether, the cities that represent exceptions to the sub-

TABLE I

REGIONS OF SUBSTANDARD URBAN HOUSING

Region	*No. of cities*	*Substandardness values*	
		Regional limits	*Mean*
West	228	Less than 28%	14.9%
Northeast	552	" " "	16.5%
Peninsular Florida	23	" " "	25.6%
Midwest-Marginal	302	28% to 44%	33.0%
Marginal New England	25	" " "	37.4%
Southeast	121	More than 44%	49.5%
Rio Grande	11	" " "	55.8%

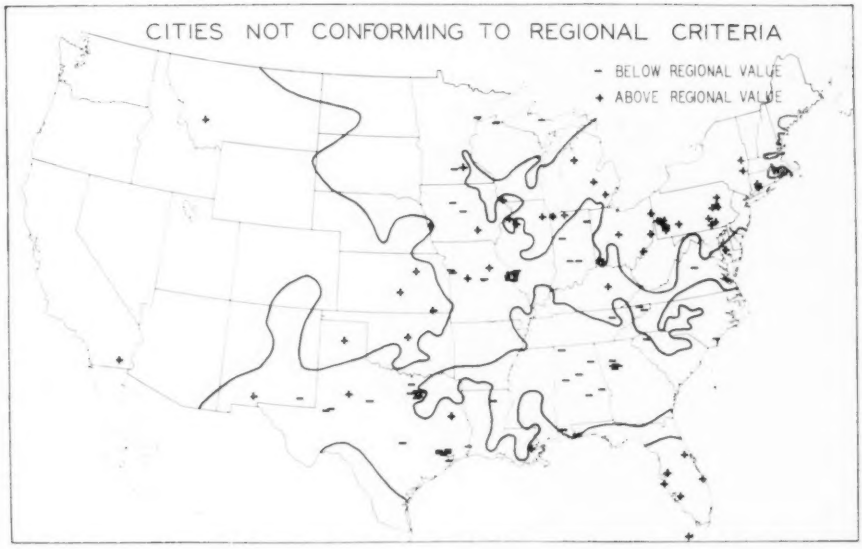

FIG. 5.

standardness characteristics of the regions in which they are located constitute only slightly over 10 per cent of the 1262 cities under study.

A SELECTION OF SAMPLE CITIES

To examine the nature of the areal variation in substandardness of housing with respect to possible associated phenomena (our third question) by means of recognized statistical procedures is a long and tedious task. For practical purposes the universe of 1262 cities is simply too large for each city to be included in the computations. Accordingly, a sample of the cities was drawn and used for this purpose.

The question as to the size of the sample is a rather complicated one. Obviously, one wishes to keep the sample size small in order to keep the problem within satisfactory work limits, but a reasonable range of reliability of estimates of the universe also is a necessary criterion. One such determination of sample size is presented by Hagood and Price.[3] It involves estimating the standard deviation of the substandardness values, and the setting of confidence limits of the estimate of the universe mean. According to this source, the standard deviation may be approximated as one-fourth to one-sixth of the range of distributions, and for our study we estimate that the standard deviation is not over 12 percentage points. If the confidence range of the mean is desired not to be in excess of 5 percentage points and therefore to set up 95 per cent confidence limits of the estimate of the universe mean, the confidence limits then will be at a distance of 2.5 percentage points on either side of the sample mean. The equation becomes $\sqrt{N} = 1.96 \times \frac{12.0}{2.5}$ where N is the number of cases required in the sample. In this case it is 89. Since this is a rough estimation and since the distribution is somewhat

[3] Margaret J. Hagood and D. O. Price: *Statistics for Sociologists*, Rev. ed., New York, 1952, pp. 279–282.

skewed, it is wise to increase the number of cases in the sample. According to the above estimations, therefore, a sample of 100 cities (an 8 per cent sample) should provide results within reasonable limits for the types of data used in this study.

Two samples of 100 cities each were drawn from the total of 1262 cities on a random sample basis. In the case of Sample A, the name of each city was typed on a small slip of paper. These names were placed in a container and continuously mixed as 100 cases were drawn at random. For Sample B, the names of the cities in each state, as well as the individual states themselves, were arranged in alphabetical order. The cities then were numbered consecutively from 1 (Anniston, Alabama) through 1262 (Sheridan, Wyoming). A random numbers table was then employed to select the sample of 100 cities.

There is no question, of course, as to the randomness of the two samples, but it is possible that through pure chance one sample might be more representative of the universe than the other. To test this possibility, the two samples were compared with each other and with the universe as to the estimation of sampling error. This involves a statistical determination of the standard error of the estimate of the mean (substandardness) of the universe. The formula used may be stated as follows: $SE = \sqrt{\frac{s^2}{N}(1-f)}$ where $s^2 = \frac{\Sigma y^2}{N-1}$, the estimate mean square deviation; N = number of sample cities (100); and f = correction factor for a finite universe[4] (1/13 in this study since one city out of every thirteen is sampled). For Sample A, the standard error of the estimate of the mean of the universe is computed to be 1.343, and for Sample B it is 1.366.

In setting up confidence limits for the estimate of the universe mean of substandardness (in this study the 95 per cent confidence level is used), it is necessary to compute two values. One value becomes the upper limit and the second becomes the lower limit at distances of 1.96 standard deviations from the estimate. Table II provides the necessary data for the establishment of confidence intervals—for Sample A it is 22.4 ± 2.6, for Sample B, 26.0 ± 2.7. This means that if an infinite number of samples were drawn by a random sample procedure, 95 out of every 100 confidence intervals would contain the universe mean. The universe mean has been computed and found to be 24.2 per cent; hence both samples A and B are in the 95 cases out of 100 wherein the universe mean falls within the limits as set. Furthermore, since both sample means deviate exactly the same amount (1.8 per cent) from the universe mean, one sample appears to be as representative of the universe as the other. Sample A was selected arbitrarily for use in this study.

TABLE II

COMPARISON OF SAMPLE ESTIMATES OF UNIVERSE MEAN

	S.E. × *S.D.*	*95 Per cent Confidence interval*	*Mean*	*Limits*
Sample A	1.343 × 1.96 =	2.6	22.4	19.8–25.0
Sample B	1.366 × 1.96 =	2.7	26.0	23.3–28.7
Universe	.....	...	24.2 (actual)	.....

[4] Frank Yates: *Sampling Methods for Censuses and Surveys*, London, 1949, pp. 185–188.

HYPOTHESES AND CORRELATION ANALYSIS

One of the purposes of quantitative geographic research is to establish principles that will "account" for areal variations. A preliminary step in this direction may be made in this study by associating a number of phenomena that present variations from city to city with variations in the proportion of substandard housing. Statistical methods of association involve procedures for determining a number of aspects of association between two or more series of phenomena. The principal summarizing measures used in this study are the Pearsonian product-moment coefficient of correlation (simple and multiple), and the analysis of variance.

Statistical correlations are useful in obtaining a rather precise measure of whether an association exists (i.e., is there a correlation?), the degree of association (how close is the correlation?), and the direction of the association (is the correlation a direct or inverse one?). They allow, in addition, a regression equation for estimating individual values of one factor by knowing the individual values of the second factor. In the correlation analyses that follow, statistical computations have been made in each case by considering substandardness of housing as the dependent variable (factor Y) and the individual factors hypothesized as having possible associations with substandardness as the independent variable (X). Each coefficient of correlation has been

TABLE III

COEFFICIENTS OF LINEAR CORRELATION BETWEEN SUBSTANDARDNESS OF HOUSING AND OTHER SELECTED VARIABLES

	Variables		*Coefficient*	*Universe Confidence Limits**	
	Family income:				
1	Less than $2500	%	.80	.72	.86
1	Median	$	−.78	−.69	−.85
5	Overcrowding	%	.72	.61	.80
5	No mechanical refrigerator	%	.82	.74	.87
5	Nonwhite families	%	.57	.42	.69
5	Renter families	%	.43	.25	.58
4	Foreign-born population	%	−.44	−.26	−.59
	Age of Structures:				
6	Built before 1920	%	.31	.12	.48
6	Built before 1920 and between 1930–40	%	.35	.16	.51
7	Average	...	.30	.11	.47
2	Age city one-half 1950 size	...	.35	.16	.51
2	Population change, 1930–50	...	.12	−.08	.31
	Temperature factors:				
5	No central heat	%	.52	.36	.65
8	Heating degree days	...	.14	−.06	.33
	Civilian labor force:				
3	Unemployed	%	.29	.10	.46
3	Employed in manufacturing	%	−.11	−.30	.09

*The probability that the interval between these limits contains the universe value is 95 per cent.

Source of data for variables:

1. U.S. Bureau of the Census. *U.S. Census of Population: 1950.* Vol. II, *Characteristics of the Population*, Washington, D.C., 1952, Table 37.
2. *Ibid.*, Table 4.
3. *Ibid.*, Table 10.
4. *Ibid.*, Table 34.
5. U.S. Bureau of the Census. *U.S. Census of Housing: 1950.* Vol. I, *General Characteristics*, Washington, D.C., 1953, Table 1.
6. *Ibid.*, Table 20.
7. Based on weighted averages from *Ibid.*, Table 20.
8. U.S. Weather Bureau. *Climatological Data: National Summary*, Vol. 3, No. 6, Table 3A, June, 1952. Clifford Strock, *Heating and Ventilating, Engineering Databook*, New York, 1948, pp. 5–63.

determined through the use of the standard formula $r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \Sigma y^2}}$.[5] A perfect correlation resulting from the use of this formula would be stated as ± 1.00, a complete lack of correlation as 0.00. For a correlation where 100 individual cases are involved, significance at the 95 per cent level is ± 0.20 or greater, and at the 99 per cent level it is ± 0.26 or greater.

The correlation results as shown in Table III indicate that a number of factors are associated with substandardness, but in varying degrees of significance. Each hypothesis under which the factors were selected as possible indicators of substandardness is considered separately as follows:

1. It is hypothesized that for the cities under study the proportion of substandard housing varies directly with the proportion of families with low income and inversely with the median income of families.

If one can assume that family groups are not likely to seek low-quality housing because they desire adverse housing conditions, it may be assumed further that families live in such housing in large measure because of inadequate economic means. In other words, the position may be taken that lack of suitable income forces most people to live in substandard housing. Of course, it must be recognized in this respect that the substandardness of housing in a given city at a given time may be the result of adverse economic conditions existing over a number of years while in the testing of this hypothesis the income character of families is considered as of a given year. Nevertheless, under the same assumption above if the income status of families in a city improves, the quality of housing tends to improve even though there may be a time lag in this association. If the hypothesis is true, housing characteristics should reflect the income characteristics of the occupant families.

There appears to be no generally accepted quantified definition of a low-income family, and for purposes of testing this hypothesis a number of quantified expressions are made, all based upon Census reported family dollar income. The family groups used and the correlation results with substandardness are summarized in Table IV.

TABLE IV

CORRELATION BETWEEN SUBSTANDARDNESS AND INCOME GROUPS

Per cent of families with incomes	*Correlation coefficient*
Less than $ 500	0.60
" " 1,000	0.69
" " 1,500	0.76
" " 2,000	0.78
" " 2,500	0.80
" " 3,000	0.72
" " 3,500	0.67

The results obtained indicate that there is a significantly high association between the proportion of families in the low-income brackets and substandardness of housing, and that the highest degree of association in this measure is with the group of families with incomes of less than $2500. Again with respect to median family income a correspondingly high association is found (−.78), although as expected the direction of association is inverse. In the testing of this hypothesis, therefore, it may be

[5] The computations required in correlation coefficient equations may be obtained from any textbook in statistics which deals with the statistics of relationship. See for example, Margaret J. Hagood and D. O. Price: *Statistics for Sociologists*, rev. ed., New York, 1952; Mordecai Ezekiel: *Methods of Correlation Analysis*, 2d. ed., New York, 1941; Henry E. Garrett: *Statistics in Psychology and Education*, 2d. ed., New York, 1937; Charles C. Peters and W. R. Van Voorhis: *Statistical Procedures and Their Mathematical Bases*, New York, 1940; George R. Davies and D. Yoder: *Business Statistics*, 2d. ed., New York, 1941.

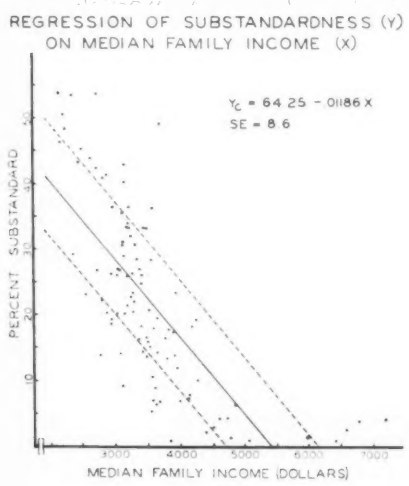

FIG. 6.

stated that cities with a high proportion of low-income families tend to have a high proportion of substandard housing, and, conversely, cities with a high median family income tend to have a low proportion of substandard housing.

In investigating further the association between family incomes and substandardness, median family incomes are used simply because such data for each city are available directly from Census reports while two-step computations must be made in each case in order to determine the percentage of families with incomes less than $2500. Further, as Table I indicates, there is relatively little difference in the coefficients of correlation of these two measures.

The nature of the inverse relationship between median family income and substandardness may be described by the regression equation

$$Yc = 64.25 - .01186X$$[6]

where Yc is the estimated substandardness for a given city and X is the reported median family income for that city. The regression or estimation line is shown graphically in Figure 6 as a straight line superimposed on a background of dots representing Census reported substandard percentages and median family income for the 100 sample cities. The scatter of the dots around the regression line merely confirms our previous finding that the correlation between these two factors while high is not perfect. The standard error of the estimate is computed as 8.6 percentage points which is also indicated in Figure 6 by dashed lines paralleling the regression line.

Brief word need be made here of the use of the standard error of the estimate. It is a measure of the dispersion or scatter of dots around the regression line. For any given series, the higher the correlation coefficient the smaller the standard error and the more accurate the estimate. In a normal distribution, roughly two-thirds of all the dots should fall within one standard error equally on either side of the regression line, and 95 per cent should fall equally within two standard errors. In the problem under consideration, 61 out of 100 cases fall within one standard error, with 18 overestimations and 21 underestimations, and 93 cases fall within two standard errors (3 overestimations and 4 underestimations). The distribution of dots around the regression line, therefore, is skewed, but the skewness is slight and should not materially affect further use of the regression equation.

Thus far the assumption has been made that the association between substandardness and median income is of linear form. The nature of the scattergram in Figure 6, however, would seem to indicate that the association might really be nonlinear, and that a curvilinear coefficient of correlation would be materially higher than the linear coefficient. The question may be posed,

[6] For development of such an equation, see Hagood and Price, *op. cit.*, pp. 414–19.

therefore, as to whether the nature of the association between these two phenomena departs significantly from linearity. The answer involves a test of the "correlation ratio."[7] In the application of this test to the nature of this association, however, the difference between the linear coefficient (–.784) and a curvilinear coefficient (–.796) does not constitute a significant departure and hence further investigation in this direction would not be profitable.

The most marked departures of the estimated substandardness of housing from the reported (actual) substandardness are found toward the extremes of the scattergram. It may be noted, for example, that estimations of substandardness are disproportionately low (beyond one standard error) where median family incomes are below $3500 and reported substandard values above 40 per cent. Since the cities with high substandard percentages (above 44 per cent) are concentrated in the Southeast and Rio Grande regions, the nature of the scattergram suggests that results from separate regression analysis for these regions would be more fruitful than further investigation of possible curvilinear relationships. Again, the regression equation overestimates substandardness for a number of cities with reported substandard percentages of less than 20 per cent, but in four of the sample cities the equation actually estimates substandardness to be less than 0 per cent. The suggestion is strong that the regions with low substandardness of urban housing (below 28 per cent) need to be analyzed separately from other regions.

The regression equation, then, possibly does not permit a higher degree of accuracy in estimating the per cent of substandard housing from median family income in every case because of *regional* differences in the association between these two factors.[8] The question which is pertinent here is whether the differences (herein called d) between the estimated and Census reported substandardness vary more within the regions of substandardness than between the regions of substandardness. From a statistical standpoint, what is involved here is an analysis of variance—the determination of the variations arising from the varying of differences (d) around their respective regional mean, and the variation arising from the varying of region means around the universe mean. Variation is a term used in this instance to refer to the sum of the squares of the deviations of the unit measure (d) from the means. The ratio of the "between region" variation to the "within region" variation is called F, and the minimum values of F at various levels of significance are available from prepared statistical tables.[9]

The computations made for the analy-

[7] *Ibid.*, pp. 449–56.

[8] Hartshorne asserts that geographers are primarily interested in areal differences in the association between two or more phenomena. "In geography the focus of attention is concentrated, not on the phenomenon—one of whose aspects is its distribution—but on the relation of that distribution to the total areal differentiation of the world. . . . The facts concerning the areal differences in these phenomena must be studied in their *areal relations*, that is, their significance to the area as determined by their relations to other phenomena of the same place, and by their spatial connections with phenomena in other areas." Or taking the liberty of substituting variables in the example given by Hartshorne, ". . . the relation of annual variations of corn production (median family income) to annual variations in rainfall (substandardness) is of great concern to the student of agriculture (economics) but is not of direct concern in geography, whereas the fact that the variations in rainfall (median income) in Nebraska have a greater effect on corn yields (substandardness), than the same degree of variation in Pennsylvania, is a geographic concern." Richard Hartshorne: "The Nature of Geography," *Annals of the Association of American Geographers*, Vol. 29, 1939, pp. 171–658. Reprinted in book form. Quotations cited above are from the 4th edition, 1951, p. 415.

[9] Hagood and Price, *op. cit.*, pp. 379–404, and Table F, pp. 562–64.

TABLE V

VARIANCE ANALYSIS OF DIFFERENCES BETWEEN ACTUAL AND ESTIMATED (FROM INCOME) SUBSTANDARDNESS BY REGIONAL LOCATION

Source of variation	*Sum of squares of d*	*Degrees of freedom*	*Mean square variance*	*Ratio of variance (F)*
Total	137,931.3	1261	.....	.....
Between Regions	57,220.9	6	9,536.8	152.0
Within Region	78,710.4	1255	62.7	

sis of variance of the differences (d) between estimated and Census reported substandardness involve all 1262 cities in the universe rather than the sample of 100 cities, since the latter by nature of its selection is a sample of the universe rather than a combined sample of the individual regions. The result of the analysis may be summarized as shown in Table V. The minimum value of the F ratio required at the various levels of significance is 1.00 where 1262 cases are involved. Since the ratio of 152 in this instance exceeds the required ratio, it is highly significant. Thus the variation of region means of d is significantly greater than the variation of d units within regions. In other words, the degree of association between substandardness and median family income varies from region to region. For more accurate estimation of substandardness for each city, it would be necessary to compute separate coefficients of correlation and regression equations for each region.

2. It is hypothesized that for the cities under study the proportion of substandard housing varies directly with the proportion of families with low *real* income.

It has been found that cities with a high proportion of substandard housing tend to have a high proportion of families with low income. Quantification of the latter has been accomplished through the use of Census-reported dollar incomes of families in each city. Certain inadequacies inherent in this quantified measure, however, must be recognized. The dollar incomes of families as reported by the Census are based on a 20 per cent sample so that the correlation results are based on a sample of a sample. More seriously, a refined analysis of the association between the proportion of low income families and substandardness of housing calls for a measure of *real* income rather than of dollar income. Whether a given family is a part of the low income group of the city in which it resides depends as much upon the character of the family (number and types of individuals)[10] as upon its dollar income, and whether this same family is considered a member of the nation's low income class depends also upon the relative cost of living in the community in which it resides.[11] In other words, in the association between economic means and substandardness, it is the real income or effective buying income rather than dollar income that is decisive in determining the quality of housing that families can afford.

It is difficult to obtain an acceptable quantified measure of real family income for the cities under study. One such measure is offered in *Sales Management* (June, 1951) wherein estimates of the 1950 effective buying income of families is given for some 1600 cities in

[10] Eric Schiff: "Family Size and Residential Construction," *Amer. Econ. Rev.*, Vol. 36, 1946, pp. 97–113.

[11] Housing and Home Finance Agency: *Housing Market Analysis*, by Chester Rapkin, Louis Winnick and David M. Blank, Washington, 1953, pp. 66–67, based on Sherman J. Maisel: *An Approach to the Problems of Analyzing Housing Demand*, Doctoral dissertation, Harvard University, 1948.

the United States. The precise method of determining estimates is not revealed, hence no estimation of the reliability of the dollar figures is possible. In addition, estimates are not available for all 1262 cities under study; in fact there are no estimates given for about one-fourth of the 100 sample cities.

Overcrowding.—Mabel Walker in describing the characteristics of slum areas, states that "In some of these areas the population becomes so congested that even with low rents the property may yield good returns. This is the strange paradox of the slums—that at the end stage of the deterioration process when the area is populated by the poorest of the poor, the owner may be able to reap a profit through the sheer density of the population forced by necessity to live in the most undesirable surroundings."[12] William-Olsson in his study of the structure and development of Stockholm, Sweden, found that, in 1895, wards that had the lowest income per able-bodied adult in general had the largest number of occupants per room.[13] In personal conversation William-Olsson stated that the same relationship is true today. In the United States for the 100 sample cities under study, a moderately high association (.59) is found between the per cent of families with incomes less than $2500 and the per cent of dwelling units with 1.01 or more persons per room as reported in the Census of Housing. Thus it would appear that one evidence of low real family income is overcrowding (i.e., forced congestion).

Assuming that low real family income is indicated by some measure of overcrowding and that "1.01 or more persons per room" is an adequate index, then it could be expected that there is an association between the per cent of dwelling units with 1.01 or more persons per room and the per cent of substandard housing. That this association exists is shown by the coefficient of .72 between these two variables.

No Mechanical Refrigerators.—If it may also be assumed that families with small economic means are not able to buy certain consumer items that are classed as quasi-necessities in modern living, then lack of such an item or items in a household would serve as an indication of low real income. The Census of Housing reports contain statistics for each city on the per cent of occupied dwelling units containing mechanical refrigerators. A high correlation (.86) is found to exist between the latter and the per cent of families with incomes of less than $2500. Further a high correlation of .82 is found between substandardness and lack of mechanical refrigerators.

Overcrowding and No Mechanical Refrigerators.—It has been found that cities with a high proportion of occupied dwelling units that are overcrowded and lacking mechanical refrigerators have a high proportion of substandard housing. If the assumptions concerning these factors as satisfactory measures of real income of families are valid, then the two factors may be used in a multiple correlation with substandardness. The correlation coefficient in this case is found to be .87 and the standard error of the estimate is 6.85 percentage points. The regression equation is computed as

$$Yc = .790(OC) + .934(NMR) + .60$$

where Yc is the estimated substandardness of a given city, OC is the per cent of occupied dwelling units that are overcrowded in that city, and NMR is the per cent of dwelling units that have no mechanical refrigerators. Thirty-three of the 100 sample cities have a reported

[12] Mabel L. Walker: *Urban Blight and Slums*, Harvard City Planning Studies, Vol. 12, Harvard University Press, 1938, p. 17.

[13] W. William-Olsson: "Stockholm: Its Structure and Development," *Geogr. Rev.*, Vol. 30, 1940, Fig. 17, p. 434.

TABLE VI

VARIANCE ANALYSIS OF DIFFERENCES BETWEEN ACTUAL AND ESTIMATED (FROM OC AND NMR) SUBSTANDARDNESS BY REGIONAL LOCATION

Source of variation	*Sum of squares of d*	*Degrees of freedom*	*Mean square variance*	*Ratio of variance (F)*
Total	93,633.8	1261	74.2	
Between Regions	25,273.4	6	4,212.2	77.3
Within Regions	68,360.3	1255	54.5	

substandardness beyond one standard error of the estimate of which 17 are overestimated and 16 underestimated.

An examination of the scattergrams of the association between substandardness and overcrowding and between substandardness and no mechanical refrigeration suggests once more that there are regional differences in the multiple association among these three factors. Once again computations for the analysis of variance of the differences between estimated and census reported substandardness involve all 1262 cities in the universe, and the results may be summarized in Table VI.

Since the ratio of 77 exceeds the required ratio of 1, the variation of region means of the overestimations and underestimations (referred to as d) is significantly greater than the variations of d units within regions. As in the previous case, more accurate estimations of substandardness for each city require separate coefficients of correlation and regression equations for each region.

3. It is hypothesized that the proportion of substandard housing varies directly with the proportion of population groups restricted in residential choices.

It is a well-known fact that certain minority groups in our society do not have unrestricted freedom in choice of residential neighborhood. "We cannot emphasize too strongly that adequate housing for minority groups represents one of the most important and most difficult segments of the entire housing problem. Generally low incomes, almost universal lack of available sites, frequent lack of mortgage finance and a tradition of neglect of their market complicate the housing problems of minorities."[14] Such restrictions, however, do *tend* to disappear when individual families conform to American social standards of living or rise in the economic scale, except for nonwhites.

Nonwhite Families. — Traditional neighborhood restrictions as well as lower economic status serve to limit housing available to nonwhite families (for Census purposes consisting of Negroes; Indians; and Japanese, Chinese, and other orientals). The following statements, based on the 1940 and 1950 Census of Housing reports, may be offered in evidence:

a. Nonwhites comprised 10.3 per cent of the total population in 1950, but occupied only 8.6 per cent of all occupied dwelling units.

b. For nonfarm areas, the nonwhite population rose by nearly 40 per cent while the number of dwelling units it occupied increased by only 31 per cent for the 10 year period ending April, 1950.

c. The proportion of overcrowded units (more than 1.5 persons per room) among nonfarm dwellings occupied by nonwhites in 1950 was four times as high as that for whites, and the nonfarm rate of doubling (married couples rooming with other families) was 2.5 times as high among nonwhites as among whites.

d. In urban housing, the proportion of dilapidated homes among nonwhites in

[14] "Report of the Subcommittee on Housing for Low-Income Families," *Recommendations on Government Housing Policies and Programs:* a Report to the President of the United States. The President's Advisory Committee on Government Housing Policies and Programs, Washington, D.C., Dec., 1953, p. 257.

1950 was almost six times as high as among whites and, in addition, the proportion of homes not dilapidated but lacking in either running water, private flush toilet, private bathtub or shower was nearly three times as high among nonwhites as among whites.

e. The proportion of nonfarm home owners among nonwhites during the decade 1940–50 rose by 93 per cent and among whites by 70 per cent, yet nearly two-thirds of the nonwhite households in nonfarm areas were still renters in 1950 compared with 45 per cent of white nonfarm households.

f. The upward shift in distribution of rents paid from 1940 to 1950 in urban areas were such that the increase in median rents for nonwhite dwelling units was 100 per cent as compared with 50 per cent for white homes.

g. The Census estimates of nonfarm family incomes for 1949 indicate that approximately half of the nonwhites had annual incomes of $1700 or more, and the other half below that figure. For whites, the halfway mark was about $3400, twice as great. Approximately 19 per cent of the nonwhites, but 60 per cent of the whites received incomes of $3000 and over.[15]

For the 100 sample cities under study, a moderately high significant coefficient (.57) is found between the proportion of occupied dwelling units inhabited by nonwhite families and that of substandardness of housing. The standard error of the estimate of substandardness from the regression line (11.5 percentage points), however, is not markedly below the standard deviation of the reported substandardness values from their mean (13.9). Knowledge of the nonwhite family proportion for a given city does improve the estimate of substandardness for that city, but not greatly.

The scattergram of these two variables (Fig. 7) around the regression line indicates that for cities with a low per cent of nonwhite families the per cent of substandardness ranges from .7 per cent to 53.5 per cent. Of the 36 cities with substandardness values falling outside one standard error of the estimate, for example, 26 cities (or 72 per cent) have less than 6 per cent of their dwelling units occupied by nonwhites. Nonwhite families apparently constitute too small a proportion of the total families in many of the cities under study to "explain" on a satisfactory basis the proportion of substandard housing. It is to be expected, however, that regional variations occur in the association among the proportions of substandardness, low income and nonwhite families.

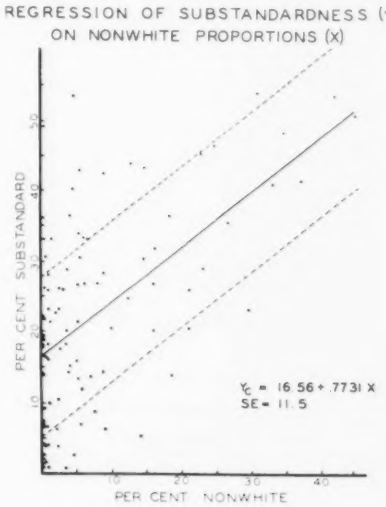

FIG. 7.

Foreign-born Population.—Because newcomers to this country can easily be recognized by distinctive homeland cultural ties and language differences, and because they are relatively powerless economically and politically, immigrants traditionally have been convenient targets for opposition and aggression.[16] Foreign-born people in urban centers, particularly where they constitute sufficient numbers to be recognized as distinct social groups, have

[15] Housing and Home Finance Agency, *Housing of the Nonwhite Population, 1940 to 1950*, Office of the Administrator, Division of Housing Research, Washington, D.C., July, 1952, pp. 1, 2 and 11, Table 11, p. 34, and Table 19, p. 41.

[16] George E. Simpson and J. M. Yinger: *Racial and Cultural Minorities* (New York: Harper & Bros., 1953), p. 111.

tended to cluster in "immigrant neighborhoods" in the poorer residential districts, although such neighborhoods have been on the decline since about 1924 due to a marked decrease in immigration and gradual assimilation of the existing foreign-born and their descendents. While only 6.7 per cent of the population of this nation in 1950 was classified as foreign-born white ("other races" add little to the total), 83.5 per cent of the total foreign-born resided in urban places.[17] With voluntary as well as involuntary restrictions in residential neighborhood choices assumed by many foreign-born people, certain characteristics of the association between the proportion of substandardness and that of foreign-born for the cities under study are worthy of consideration.

The assumption of a direct correlation between the per cent of substandardness and the per cent of the population 21 years old and older that is foreign-born is found to be incorrect. The scattergram in this case shows that cities with a high proportion of foreign-born (above 20 per cent) have a low proportion of substandardness (below 20 per cent), while cities with a low proportion of foreign-born (below 10 per cent) have substandardness values which range from the lowest to the highest. The correlation is found to be −.44. Further study of the nature of the nation-wide distribution of the urban foreign-born reveals that 64 per cent live in only 14 of the largest urbanized areas,[18] 11 of which are in the Northeast substandard region and three on the west coast. These urbanized areas (all over 500,000 population) have a large quantity of substandard housing, but the per cent of substandard to total housing is low. The conclusion may be drawn that the details of the association between foreign born and substandardness must be examined on a regional basis or, probably, on an individual city basis.

Renter Families.—"One of the outstanding changes in the housing picture over the last sixty years has been the increase in home ownership. In 1890, only a little over one-third of all nonfarm homes were occupied by their owners. By 1950 more than one-half were owner-occupied."[19] The rate of increase in home ownership was particularly high during the 1940's. Among white occupants of urban dwelling units, for example, 52 per cent owned their homes in 1950 as against 39 per cent in 1940, and among nonwhite occupants 32 per cent owned their homes in 1950 against 20 per cent in 1940.[20]

It is entirely probable that in our urban places rental units are occupied to a significant degree by low income families and by minority-group families restricted in choice of housing. Cities with a high proportion of substandardness of housing, at any rate, tend to have a high proportion of renter families (the correlation is .43). Further, cities with a high proportion of renter families tend to have a high proportion of nonwhite families although to a lower degree (correlation .34). Thus in an analysis of regional differences in the association of certain factors with substandardness, further consideration need be made of the multiple association of rental and nonwhite status of families with inferior housing qualities.

In summary, the hypothesis under consideration may now be stated more precisely: the proportion of substandard

[17] U. S. Bureau of the Census. *Census of Population*, Vol. II, Part 1, Table 49.

[18] U. S. Bureau of the Census. *Census of Population: 1950*, Vol. II, Parts 2–50, Table 34.

[19] Housing and Home Finance Agency. *The 1950 Housing Situation in Charts*, Office of the Administrator, Division of Housing Research, Washington, D.C., October, 1951, p. 20.

[20] U. S. Bureau of the Census. *Census of Housing: 1950*. Vol. I, Part I, Table 3.

housing in a given city tends to vary directly with the proportion of dwelling units occupied by nonwhite and by renter families, and inversely with the proportion of the population over 20 years of age that is foreign born.

4. It is hypothesized that the proportion of substandard housing varies directly with the age of dwelling-unit structures.

Since it is clear that structural dilapidation often is the result of long continued use and exposure to the elements, and since structures built in an earlier era often lack modernization of plumbing facilities, it may be hypothesized that the older the residential structure of a given city the greater the proportion of substandardness. Several correlation tests of this hypothesis are summarized in Table VII.

TABLE VII

CORRELATION BETWEEN SUBSTANDARDNESS AND AGE FACTORS

	Coefficient
Per cent of dwelling structures:	
Built before 1940	.31
Built before 1930	.28
Built before 1920	.31
Built before 1920, and between 1930–40	.35
Average age of dwelling structures	.30
Age city was one-half its present size	.35

The results of the tests are inconclusive. The direction of association in each case is positive but there is little difference in the results of each age period used. Further, in the sample study, six of the seven correlations are statistically significant but, when the coefficients are converted to universe limits based on a 95 per cent confidence level of probability, doubt is cast upon the degree of significance of the correlations (see Table I).

Several difficulties arise in the use of available data relating to the age factor. In the first place, the year built as reported by the Census Bureau refers to the year of the completion of the original construction, without regard to later extensive reconstruction, remodeling or addition, or conversion to housing. Thus, age of structures as reported, where considerable renovating is undertaken, is a poor index of "aging-toward-dilapidation" or lack-of-sanitary facilities. Second, the Census Bureau warns that data on year built are subject to some inaccuracy because of errors of response and nonreporting.[21] Enumerators relied in most instances upon the memory of the person interviewed as to the year of construction. Third, and perhaps most important, the oldest age category reported, "structures built before 1920," appears too broad for correlation purposes—an average of 44 per cent of the residential structures in the 100 sample cities were built in this period as against an average of 22.4 per cent of all units counted as substandard. The minimum span of 31 years (from 1950 to "built before 1920") probably does not provide sufficient time for substandardness resulting from age to become apparent. The federal Internal Revenue Service, for example, in setting up tables based on reasonable rates of depreciation for buildings of standard construction, considers 60 years as reasonable for the useful life of residential structures.[22] Finally, it must be recognized that the substandardness of dwellings can result from inadequate original construction as well as from aging. In the correlations attempted on age of structures, the highest correlation obtained was arrived at by combining the number of structures built before 1920 with those built during the depression period 1930–40. Since by combining depression-built

[21] U. S. Bureau of the Census. *U. S. Census of Housing: 1950*, Vol. I, Part I, p. XVIII.

[22] Bulletin "F," *Tables of Useful Lives of Depreciable Property*, Internal Revenue Service Publication No. 173, 1955 (rev. 1942 ed.), p. 7.

housing with older housing the correlation with substandardness is improved, the idea persists that it is possible that the faster a city changes in numerical size the more likely substandardness of housing will appear. A correlation of .12 between substandardness and per cent population change, 1930–50, however, discourages possibilities of significant associations in this respect.

If age is a factor that is significantly associated with substandardness of housing, more precise data are needed. This is particularly true if age and substandardness are to be studied in their regional associations since age of structures varies considerably from the eastern to the western sections of the United States.

5. It is hypothesized that the proportion of substandard housing varies inversely with normal heating requirements for comfortable living.

The facts that a moderately high significant association (.52) exists between substandardness and the proportion of dwelling units lacking central heat, and that cities with the highest proportion of substandardness are concentrated in the South and Rio Grande regions, suggest the possibility that substandardness is associated in some significant measure with certain climatic conditions. On the assumption that housing conditions probably vary more with temperature conditions, particularly the severity of winters, than precipitation or other climatic factors, a quantified measure of the effect of temperature on normal living comfort is worthy of correlative consideration. Such a measure can be obtained through the use of the concept "degree day." A difference of one degree per day in the mean daily temperature below 65°F. (considered by heating engineers as the minimum temperature of bodily comfort in the home) is one degree day, and the number of degree days below 65°F. in a normal heating season is the sum of all the daily values for that season. The number of degree days in the heating season for the cities under study can be obtained by interpolating from data provided by the Weather Bureau for selected cities scattered over the United States.[23]

The correlation of this climatic factor with substandardness, however, is .14, with universe limits of −.06 and +.33. The association is deemed not significant for the urban places under study and hence the hypothesis must be rejected.

6. It is hypothesized that the proportion of substandard housing varies directly both with the percentage of unemployment and the percentage of the civilian labor force engaged in manufacturing.

Unemployment.—In the previous discussion of the association between income and substandard housing, it was pointed out that the income characteristics of a city could change rapidly while the housing characteristics would tend to change more slowly. In other words one factor is likely to be more dynamic in change than the other. In spite of this contrast, however, it was demonstrated that there is a highly significant association between family income characteristics and substandardness of housing. The percentage of a city's civilian labor force that is unemployed is probably subject to even more rapid changes than the median family income. If, however, a city is subject to long periods of large-scale unemployment it would be expected that this would be reflected in the income of the people and in turn in the quality of the housing. When the per cent of the labor force that is unemployed is correlated with

[23] *Climatological Data: National Summary*, U. S. Weather Bureau, Vol. 3, No. 6, Table 3A, June, 1952. For additional data and isoplethic map, see Clifford Strock, ed.: *Heating and Ventilating Engineering Databook* (New York: The Industrial Press, 1948), pp. 5–63.

the per cent of substandard housing the coefficient is found to be .29. This is statistically significant but indicates only a slight degree of association between the two variables.

Employed in Manufacturing.—It is a well known and easily observed fact that residential areas in or near manufacturing districts of the heavy industry type tend to be of poor quality. From this it is postulated that if a city has a high percentage of its labor force engaged in manufacturing it will have a high proportion of substandard housing. This is, however, an erroneous assumption. Figure 3 indicates that northeastern United States, which is highly industrialized, is for the most part a region of low substandardness of housing. The coefficient of correlation between the two variables is −.11, which is not statistically significant, indicating that for the nation as a whole one is just as likely to find high proportions of substandard housing in cities with a low proportion of their labor force in manufacturing as in cities with a high proportion in manufacturing. Further, an analysis of the 152 metropolitan areas with populations of 100,000 or more indicates that there is a slight tendency for the median family income to increase as the percentage of workers engaged in manufacturing increases (.39). No concrete conclusions can be presented at this point, however, because of the rather crude nature of the data used. The original hypothesis uses a mechanism based on heavy industry (a term difficult to define) and the test of the hypothesis utilizes data on the percentage of workers in all types of manufacturing. A refinement using the percentage of workers in certain of the Census Industry Groups would perhaps provide more fruitful results, particularly in a regional framework of study.

SUMMARY AND CONCLUSIONS

Attention in this study has been focused on a comparative analysis of the proportion of substandardness of urban housing. Three specific aspects of substandardness have been investigated: the nature of the variations in the proportion of substandard housing of 1262 cities with populations of 10,000 and over, the characteristics of the variations in substandard proportions as areally distributed in the United States, and the nature of the areal variations in substandardness with respect to the areal variations of certain selected phenomena.

It has been demonstrated that there is considerable variation in the proportion of substandard housing of American cities, that there is regional differentiation in substandardness, and that there are a number of factors associated in significant degree with substandardness. Factors which appear to be relatively good indicators of substandardness are the proportion of families with low income (monetary and "real") and the proportion of certain family types restricted in choice of residence. Age of residential structure and unemployment appear to be relevant factors although no real significance can be attached to them, possibly because of certain difficulties inherent in the use of the types of data available. While no attempt has been made to "explain" on a statistical basis the total variation among substandardness in terms of other variables,[24] it is hoped that in the formulation of the problem and in the selection of variables guided by hypotheses based on current theories in the

[24] An excellent presentation of multiple regression analysis techniques is found in Donald J. Bogue and D. L. Harris: *Comparative Population and Urban Research Via Multiple Regression and Covariance Analysis*, Scripps Foundation Studies in Population Distribution, No. 8, Oxford, Ohio, 1954.

systematic social sciences, the foundation is laid for possible future retesting of results. A word of warning is necessary here: the "explanations" of substandardness do not necessarily imply direct cause-and-effect relationships. No one can be certain that the associated variables will maintain a stable or predictable relationship in the future, or that these variables have been relevant or irrelevant in the past. Repeat studies based on later Census years will be necessary for the verification or rejection of findings.

Since the degree of association between substandardness and a number of the variables studied appears to vary from substandard region to substandard region, more accurate estimations of substandardness for individual cities appear to require a determination of separate coefficients of correlation and regression equations for each region. In a correlation between substandardness and "no mechanical refrigerators" in the Southeast region, for example, where a sample of 40 out of 121 cities is used, the coefficient obtained (.52) is substantially lower than for a sample of the entire universe (.82).

Furthermore, in the use of separate regional regression equations to identify specific cities that are highly overestimated and underestimated in substandardness, it is within the realm of possibility that a disproportionate number of these cities are located along the margins of regions. If such be true, and this possibility is worthy of investigation, then a revision of regional boundaries could be based on multiple associations of independent variables with substandardness rather than on one criterion alone (i.e., per cent substandardness). In other words, in continuing the study of the geographic characteristics of substandard housing along the lines outlined above, an investigation of regional differences in the association of substandardness with variables selected within a theoretical frame of reference might possibly lead to a discovery of substandard-complex regions based on multiple associations.

INTERNAL EXCHANGE OF STAPLE FOODS IN THE GOLD COAST

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IN Intertropical Africa by far the greater part of the economic effort is absorbed in the production of food for subsistence. In spite of the considerable degree of economic development in progress there, the Gold Coast is no exception to the rule. In the most recent census, that of 1948,[1] 72.2 per cent of the male working population was recorded as being wholly engaged in agriculture. Yet, apart from cacao, agricultural produce accounted for only 1.8 per cent of the value of the 1953 exports, while over 15 per cent of the imports were represented by foodstuffs alone. Even the 162,000 cacao farmers grew the larger part of the food consumed by themselves and their dependents. In a typical cacao growing village it was found that 88.3 per cent of the vegetable foods consumed were produced on a subsistence basis.[2]

The proportion of food crops disposed of for cash is, however, increasing. The larger towns and mining centers, in which the majority of the inhabitants are no longer directly concerned in the land, are expanding. Even in the smaller agricultural settlements, specialists such as teachers, truck drivers, and postal clerks are now to be found.

[1] All figures relating to population have been taken from "The Gold Coast: Census 1948," Gold Coast Government, Accra, 1950.

[2] J. H. Beckett: "Akokoaso," London School of Economics Monograph on Social Anthropology, London, 1944, p. 21.

This paper is concerned with the internal exchange of staple foodstuffs in the Gold Coast and with the problems involved in attempting a quantitative analysis.

The Exchange Economy

Daryll Forde divided the exchange economy of Nigeria into three sectors: *subsistence*, *internal*, and *external*.[3] It would seem better, at least in the Gold Coast, to distinguish between *local* and *internal* exchange. Local exchange may be described as the satisfaction of the needs of a small community by production within the community. The produce is disposed of on a barter or cash basis. Internal exchange may be thought of as involving movement of produce outside the local community in order to satisfy the needs of another part of the same country. Local exchange of foodstuffs is of very long standing in the Gold Coast. It is the internal exchange that is of recent development and which is linked to the general economic development of the country.

Geographical Background

The Gold Coast is, in most respects, the most economically-advanced of the four British West African Territories.

[3] D. Forde and R. Scott: *The Native Economies of Nigeria*, London, 1946, p. 32.

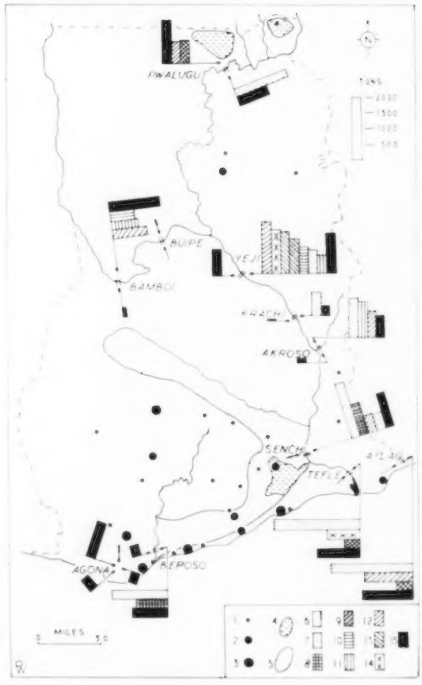

FIG. 1 (left). Key map. Numbers refer as follows: 1, international boundary; 2, internal political boundary; 3, area of closed forest (Forest Zone). The Coastal Savannas are to the southeast of the Forest Zone and the Northern Savannas to the north.

FIG. 2 (right). Map to show areas of surplus and deficit of staple foods, and location of Department of Agriculture check points and traffic recorded at them in 1952. Numbers refer as follows: 1, towns with 5000 to 10,000 inhabitants; 2, towns with 10,000 to 20,000 inhabitants; 3, towns with over 20,000 inhabitants; 4, areas of close rural settlement (over 200 per square mile); 5, main areas of surplus; 6, yam; 7, cassava; 8, maize; 9, rice; 10, millet; 11, guinea corn; 12, groundnuts (peanuts); 13, cowpeas; 14, fish; 15, other foodstuffs. Check points are located at ends of arrows.

It has an area of 91,843 square miles and a population in 1948 of 4,118,450, of which about 550,000 live in urban areas of over 5000 inhabitants.

The country is divisible into three clearly marked geographical divisions which follow those of rainfall and natural vegetation. They are the Forest Zone, the Coastal Savannas, and the Northern Savannas.

The Forest Zone is the most productive. It is here that the whole of the cacao is grown. It also happens to include the areas of mineral production. Here gold, manganese, bauxite, and to some extent diamonds are produced under conditions of modern, large-scale technology. The Forest also produces large quantities of staple food crops: chiefly plantain, cocoyam (taro), cassava (manioc), and maize. Thus, although the Forest covers less than a third of the country, about half the population lives within it.

To the southeast are the Coastal Savannas, coinciding with the belt of rainfall deficiency that extends eastward from Cape Three Points. Here the choice of crops is extremely limited. Cassava is virtually the only staple crop, though maize can also be grown in the wetter parts. The population of

this region is about 750,000, of which over 200,000 live in the three towns of Accra, Sekondi-Takoradi, and Cape Coast (Fig. 1).

Northward, the Forest also merges into savanna (the Northern Savannas), though, for the most part, tree growth is considerably thicker here than it is in the Coastal Savannas. This condition reflects a greater effective precipitation, and there is thus a wider choice of crops. In the southern part of the region the staple foods are yam, guinea corn (sorghum), and pulses. In the drier north, millet replaces yam as the chief staple. The population of this very large region is in the order of 1.3 million, of which very few are urban dwellers.

REGIONS OF SURPLUS AND DEFICIT

It follows from such a geographical background that there is considerable regional variation in the quantities of food produced and in the proportion of non-food producing population. Figure 2 has been prepared, therefore, to show the main areas of surplus and deficit in food production.

The areas of deficit, into which staple foods must be imported from neighboring communities, may be regarded as urban settlements, towns, and mining centers with over 5000 inhabitants, and very closely settled rural areas. It was considered that the food requirements of towns of less than 5000 could be met from local resources.

The areas of surplus are to be found chiefly on the fringes of the Forest around the main cacao producing region. In northern Ashanti this area also includes savanna lands where large quantities of yam and grain are raised as cash crops. The remainder of the country may produce a surplus in certain areas, but single villages will make a very small contribution.

AVAILABILITY OF SOURCE MATERIAL

The study of economic geography in Tropical Africa is, except for external exchange, constantly hampered by lack of statistical material. Hence, geographers have hitherto directed their attention largely to that sector. Other studies must rely mainly on personal observation in the field and on subjective analysis. The only exceptions have been the work of large teams studying restricted areas. Of this nature have been the studies of Beckett,[4] Fortes,[5] and the Government Statistician.[6]

There is, however, some material available in the Gold Coast that can be used partially to measure the internal exchange of staple foodstuffs. This material consists of estimates of truck loadings which are obtained from passing traffic at certain check points. The checks on traffic are applied in two forms. The first is by the Department of Agriculture, which maintains a limited number of permanently manned posts. The second is by the Government Statistician's Office, in which a large number of temporary posts are manned over limited periods. By kind permission of the departments concerned, these figures were made available.

The permanent check points are particularly useful in measuring the growth of external exchange over a period of time, in one case since 1929. Figure 2, based on these figures, shows the location of the check points and the relative importance of the traffic passing them.

With this information the contribution of the savanna lands of the Northern Territories, though not those of Ashanti, to the internal exchange economy can

[4] I. H. Beckett: *op. cit.*

[5] M. Fortes and R. Steel: "Ashanti Survey," *Geogr. Journ.*, Vol. 60, 1948, pp. 149–179.

[6] "Agricultural and Statistical Survey of South Eastern Akim-Abuaka," Office of the Government Statistician, Accra, 1953.

be effectively measured. In addition, that of certain areas within them, subregions of the Northern Savannas, can also be distinguished, for there are check points at the only exits from these areas. The contribution of the Forest and Coastal Savannas east of the Volta can be measured, too, as there are check points on all the important routes into and out of the area.

But, on the other hand, little can be learned of movements within the most important areas, the Colony and Ashanti. In this connection, the figures collected as a result of two surveys made in 1953 by the Government Statistician's Office shed much light on movements in the environs of Accra. When there is more than one check point on a route leading to a known area of deficit, it is possible, by comparing the figures for each commodity obtained at each succeeding check point and by taking into account the geographical features of the area, to ascertain whether the area served by the road between the two check points was in fact one of surplus or deficit, and therefore to assess its contribution to the supply of the terminal area of deficit. If the figure obtained at any one check point is higher than that obtained at the previous point, the intervening area produced an exportable surplus. If the figure is lower, the intervening area was one of deficit. By examining the figures in this way, it is possible to delimit the various food producing regions concerned in the supply of Accra, and to assess their relative contributions.

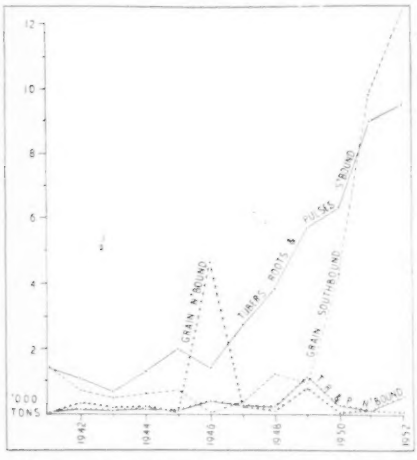

FIG. 3. Volta Ferries—movement of selected crops, 1941–1952. The Volta Ferries are five in number and include Bamboi, Buipe, Yeji, Krachi, and Akroso.

SOUTHWARD MOVEMENT FROM THE NORTHERN TERRITORIES

Figure 3 has been prepared to show the movement of staple foodstuffs across the Volta ferries between the Northern Territories and Ashanti.

It is immediately apparent that southbound traffic is rapidly expanding, a reflection of the growing contribution of the Northern Territories to the internal exchange. Hitherto, the pace of economic development has lagged considerably behind that of the rest of the country. Internal exchange, however, is only beginning, and, to put the matter into perspective, it must be remembered that something in the order of 600,000 tons of food must be harvested annually in order to satisfy the needs of over a million people directly dependent on subsistence agriculture. Of this quantity, 20,000 tons moved southward in 1952, no more than 3.3 per cent. It is because this proportion is so small that there are such violent fluctuations in this traffic. It is only the most marginal surplus that moves, and a change of several hundred per cent in the export figures may be the result of a negligible variation in the harvest. A complete reversal of flow may occur in any one year, as in 1946, when it was probably the result of discharged soldiers buying large quantities of grain for brewing.

We are now in a position to analyze

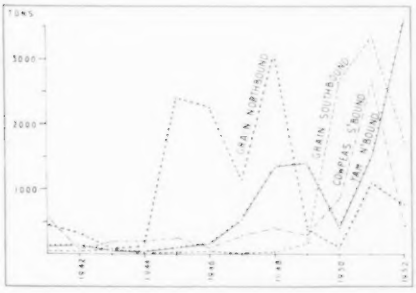

FIG. 4. Pwalugu Ferry—movement of selected crops, 1941–1952.

the exchange economy in foodstuffs of North Mamprusi, a very closely-settled area in the extreme northeast (Fig. 1). In Figure 4, which gives details of traffic across Pwalugu Ferry, the only southward exit from North Mamprusi, the same tendencies can be seen that are revealed by Figure 3. There is a general increase in internal exchange, but at the same time a very small proportion of the output enters trade, and there are violent fluctuations which do not reflect equally violent fluctuations of yield.

To illuminate the position still further and to show the long term trends more clearly, net southward movements were calculated as moving averages (Figs. 5 and 6). The closely-settled North Mamprusi is now clearly seen as a net importer of staples, at least until very recently. This was the result of population pressure, relieved by temporary migration southward and the return of the migrants with wages in cash. In the last few years there has been a net export, though this is too small to imply any drastic reorganization of agricultural practices. It may be the result of the gradual introduction of mixed farming under the guidance of the Department of Agriculture. Not only has the export of peanuts (ground nuts) and cowpeas expanded, but an entirely new cash crop, swamp rice, has appeared. In 1948, twenty-three tons were sent southward, and in 1952, 1537 tons.

Traffic moving southward from the Northern Territories mainly uses Yeji and Akroso ferries. It follows, therefore, that the thinly-populated savannas to the north of those ferries are the principal contributors to southbound traffic rather than the savannas to the west. Some, though not all, of the recent increase has been the result of the diversion of foodstuffs previously going to North Mamprusi, and of the small contribution of the last named. By subtracting the Pwalugu figures from those of Yeji we find that the

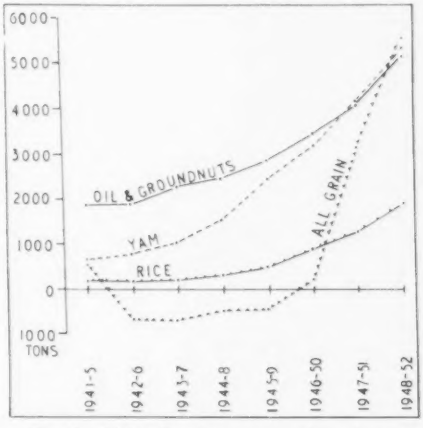

FIG. 5. Volta Ferries—net southward movement of selected crops, five-year moving averages.

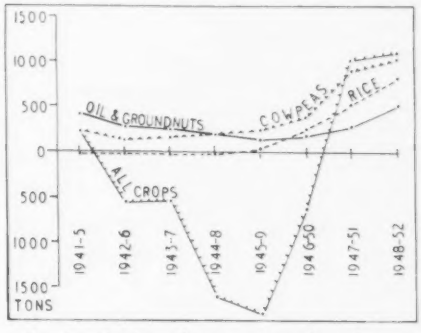

FIG. 6. Pwalugu Ferry—net southward movement of selected crops, five-year moving averages.

TABLE I

THE RELATIVE CONTRIBUTION OF THE AREA NORTH OF AKROSO AND THAT BETWEEN AKROSO AND SENCHI TO THE SUPPLY OF ACCRA

1952

	Southbound traffic at		*Contribution of*	
	Akroso	*Senchi*	*Area north of Akroso*	*Area Akroso-Senchi*
Groundnuts	1,755	1,060	695	NIL
Guinea corn	3,474	952	952	NIL
Rice	680	411	411	NIL
Cassava products	191	1,042	191	851
Maize	70	2,132	70	2,063
Total	6,170	5,597	4,852	4,011
			=4% of the annual import into Accra of 120,000 tons	=3.3%

N.B. All figures in tons.

intervening country produces a surplus of peanuts, millet and guinea corn, yams, cowpeas, and rice. The country to the north of Akroso does not export such a variety, only yams, guinea corn, and peanuts being of any importance. All save the recently-introduced swamp rice are typical products of the Guinea savannas.

The destination of this southbound traffic must remain partly conjectural. It must be assumed that traffic across Bamboi and Yeji is mainly for Kumasi and the northern part of the cacao belt. On the other hand, it is possible to compare the figures for Akroso Ferry with those for Senchi (Table I). In this way, the proportion of traffic retained in South Togoland and Trans-Volta in the first place and that exported across the Volta in the second place can be arrived at. As will be shown later, the latter traffic was used directly or indirectly in the supply of Accra, representing about 4 per cent of its food needs.

WESTWARD MOVEMENT FROM SOUTH TOGOLAND AND TRANS-VOLTA

The figures for Senchi Ferry are of particular interest in that they have been collected over a considerable period, since 1929 in fact. The now familiar growth of internal exchange is seen to extend over at least 25 years, but the rate of increase has been greatly speeded up since the war (Fig. 7).

From these records and those made at Akroso, Aflao, and Tefle an accurate picture can be built up of movement into and out of South Togoland and Trans-Volta, an area which includes the forest and coastal savannas east of the Volta.

The variety of commodities involved in this movement has increased, for the products of forest and coastal savannas have been added to those of the northern savannas entering at Akroso. The chief exportable surpluses of the forest area are maize and cassava, the latter mainly in the form of *garri* or cassava flour, and those of the coastlands are salt and fish.

If eastbound traffic is compared with westbound traffic, it will be seen that the movement of agricultural staples is all westward, the areas to the east and north taking salt and fish in exchange.

The extent to which staple foods moving into the area are retained within it can be seen from Table II. While in

TABLE II

LOCAL SURPLUS AND DEFICIT OF FOOD CROPS IN SOUTH TOGOLAND AND TRANS-VOLTA, 1950–1952

	1952 Imports into the area			*1952 Exports from the area*					
	Via Aflao	*Via Akroso*	*Total Imports*	*Via Tefle*	*Via Senchi*	*Total Exports*	*+/− 1952*	*+/− 1951*	*+/− 1950*
Cassava Products	5,287	191	5,478	5,622	1,042	6,660	+1,182	−1,111	− 699
Yam	417	2,533	2,590	34	3,630	3,664	+ 714	−1,912	−1,837
Maize	1,098	70	1,168	280	2,132	2,412	+1,264	−1,584	−1,012
Cowpeas	3,289	36	3,325	619	412	1,031	−2,294	−1,572	−1,664
Groundnuts (peanuts)		1,755	1,755	49	1,060	1,169	− 586	− 319	− 242
Guinea Corn	396	2,374	2,770	78	952	1,030	−1,740	−1,673	− 249
Rice	680	1,011	1,691	478	411	889	− 802	− 926	−1,081
Total (all food crops)	13,032	8,209	21,241	8,331	10,939	19,270	−1,971	−5,085	−5,049
Add export of:—									
Fish							+2,358	+3,378	+1,083
Copra and Coconut Oil							+3,994	+ 850	+ 919
Salt							+5,821	+5,964	+7,495

N.B. All figures in tons.
Surpluses shown as +.
Deficits shown as −.
Details not shown for 1951 and 1950.

any one year there may be a surplus and consequent net export of any one commodity, there is an overall deficit of staple foods. This, however, is more than balanced by a constant surplus of salt, fish, and coconut products, much of which enters the external exchange, crossing the frontier into French territory.

So far only the peripheral areas have been considered. The surplus produced in them and entering the internal exchange, though expanding, is small in proportion to the needs of the more advanced areas of the Colony and Ashanti. In short, these peripheral areas have not as yet advanced far beyond a subsistence or local exchange economy.

THE FOOD SUPPLY OF ACCRA

It is now time to analyze the results of the surveys made by the Government Statistician's Office. Those of the first survey, carried out July 1–14, 1953, are recorded diagrammatically in Figure 8. While there are a few cross currents, the main movement is toward Accra. The aggregate amount of food entering

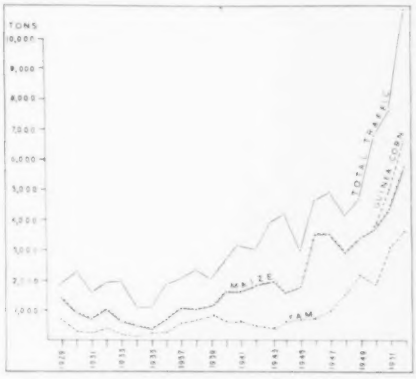

FIG. 7. Senchi Ferry—westbound traffic in staple foods, 1929–1952.

the town was 5585 tons, of which 4652 tons were retained. This represents an annual per capita consumption of .77 tons, which agrees closely with a previous estimate of .78 tons made by the Department of Agriculture,[7] and seems to substantiate the accuracy of the check. It would also seem possible to assume an annual import of about 120,000 tons

[7] "Movement of Local Foodstuffs in the Eastern Part of the Colony," Office of the Government Statistician, Accra, 1953 (unpublished), p. 14.

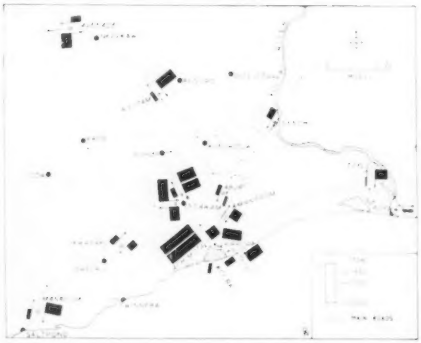

FIG. 8. Movement of staple foods in the Accra area, July 1–14, 1953.

(4652 x 26 or .78 x the estimated population of 160,000).

There are, at present, three main roads and a railway entering Accra. The traffic in local foodstuffs carried by rail is so small that it can safely be ignored, but check points set up on each road where it crosses the municipal boundary enabled all movements by road into and out of Accra to be recorded.

The movement of fish, 262 tons inward and 348 tons outward, has been ignored for the purposes of this paper. This food is not comparable on a weight basis with staples of vegetable origin either in food or cash value. In addition, it could scarcely be termed a staple in the diet of most of the people.

The net inflow of foodstuffs from the north and west past Achimota was 3374 tons or 73.1 per cent of the total of 4618 tons. Similarly, there was a net inward movement from the northeast at the Airport check point of 944 tons or 20.4 per cent of the total. Finally, a net inward tonnage of 300 was recorded as passing Teshi on the coast road from the east, 6.5 per cent of the total.

If the tonnage passing Achimota is compared with the combined net southward tonnage passing the two check points at Nsawam, 20 miles beyond, there is an excess of 1332 tons at Achimota. This represents the contribution of that part of the Forest edge south of Nsawam. This is 29 per cent of the staples entering Accra during the survey period. We have now got quantitative evidence of the importance of this extensively-farmed maize producing region.

North of Nsawam is a large food producing area centered on Suhum, a region that can be called Southern Akim-Abuakwa. Unfortunately, the next check point beyond Nsawam was at Nsutam, north of the point where two routes from the north to Accra diverge, to go via Suhum and via Koforidua. But, if we make the assumption that two-thirds of the traffic went by the Suhum route, Southern Akim-Abuakwa is found to have provided some 970 tons to the feeding of Accra, or 21 per cent of the total. This assumption is borne out by a survey made earlier in 1953 when an export of 3800 tons was recorded over a period four times as long.[5]

TABLE III

RELATIVE IMPORTANCE OF VARIOUS FOOD PRODUCING AREAS IN THE SUPPLY OF ACCRA

1. The Forest edge south of Nsawam	29 %	
2. Southern Akim Abouaka	21 %	
3. The Nkawkaw area (via Suhum)	13 %	
4. The Forest edge west of Nsawam	10 %	
5. The northeastern environs of Accra	7 %	
6. Beyond Senchi Ferry	7.4%	4 % Beyond Akroso 3.4% Between Senchi and Akroso
7. French Mandated Togoland	6.5%	
8. Assessawa (via Amantiom)	3.6%	
9. Beyond Aburi	2.6%	1.3% Assessawa (via Koforidua) 1.3% Nkawkaw area (via Koforidua)
	100.1%	

The next check point to the north, at Avenade, was the last. Although there

[5] "Agricultural Survey of Akim-Abuakwa," Office of the Government Statistician, Accra, 1953, p. 22.

was a net Accraward movement of 473 tons, there was no means of ascertaining how far beyond these foodstuffs originated, but being the normal Forest staples, it was probably not very far. This was, therefore, taken as the northern limit of the area supplying Accra. The intervening region, centered on Nkawkaw, thus supplied 13 per cent of the total, at least by the Suhum route.

The area west of Nsawam is not nearly so extensive or so important a supplier of Accra as that to the north or south. At the next check point, Kwanaku, 25 miles to the west, the net movement was westward, away from the capital. This area, west of Nsawam, supplied 480 tons or 10 per cent.

Turning to the second route, that past the Airport check, we again find a considerable excess in the tonnage passing over that passing the two check points beyond. Thus the northeastern environs of Accra supplied 312 tons or 7 per cent of the total. This is a savanna area and its products will be cassava and maize.

Beyond lies a region which plays no part in the provisioning of Accra, being an area of exceptionally close rural settlement (Fig. 2). To the north of this area is an important food-producing area centered on Assessawa. There are two routes from here to Accra, past the check at Aburi, and past that at Amanfrom. There was a net Accraward movement of 122 tons at Aburi, but although it can be deduced that this quantity, 2.6 per cent of the total, came from beyond Koforidua and the closely-settled area, there is no means of proving whether it came from the Assessawa area or the Nkawkaw area. Until further evidence is forthcoming, the proportion has been equally divided.

The net inward movement was 168 tons higher at Amanfrom than at Senchi, and, since the Senchi road passes through a densely populated area, this figure must represent the contribution of the Assessawa area, via this route, 3.6 per cent of the total. Three hundred and forty-two tons, 7.4 per cent, crossed Senchi Ferry. Four per cent of the total comes, as we have seen, from the area north of Akroso. The remaining 3.4 per cent must, therefore, come from Trans-Volta and South Togoland. This area is an overall net importer, but there would be a large seasonal surplus of maize at this time of year (July) and 141 tons of this were recorded as crossing the ferry.

At the Teshi check point, on the coast road, there was a considerable counter-flow of cassava products destined for the coastal fishing towns. It must, therefore, be concluded that this area is one of deficit and that the small net import of 300 tons came from across the Volta at Tefle. It can be seen from Table II that this area has no food to spare either, so this 6.5 per cent represents the contribution of French Togoland.

These conclusions, derived from scanty data, are offered as tentative only. The results, however, do coincide with observations made in the field. The only exception is the Assessawa area, which has the reputation and appearance of being a major food-producing area, and Assessawa market is one of the largest in the Gold Coast. These results, however, show it as supplying but 5.0 per cent of the total food requirements of Accra.

MOVEMENTS IN THE KOFORIDUA AREA

The matter can be pursued further by reference to a later survey made September 11–25, 1953, to record movements in the supply of Koforidua. With a population of 25,000 it is the only large town near Accra. Taking certain

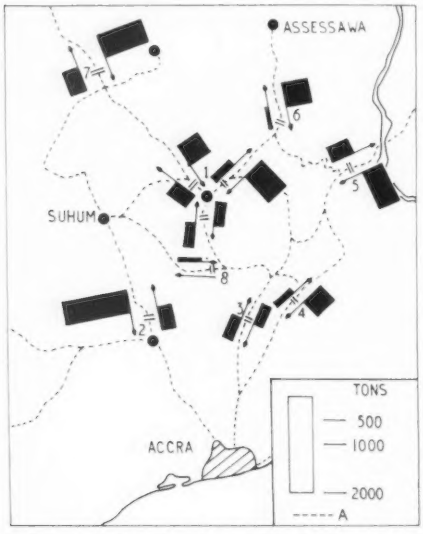

FIG. 9. Movement of staple foods in the Koforidua area, September 11–25, 1953. Key to check points: 1, Koforidua; 2, Nsawam (Suhum Road); 3, Aburi; 4, Dodowa; 5, Senchi; 6, Oterkpolu; 7, Nsutam; 8, Adawso. A. Main roads.

seasonal variations into account,[9] the two sets of figures collected at the check points common to both counts were sufficiently close to confirm the consistency of the methods adopted.

The net tonnage of food entering Koforidua was 894, coming from the north and east. One hundred and five tons were head loaded, indicating an origin in the immediate neighborhood. The net southward movement from Koforidua was 115 tons, a few tons more than that past Aburi. This amount can, therefore, be taken to be the contribution of the area beyond Koforidua to the supply of Accra. This is 2.5 per cent, almost exactly that of the previous count.

Since, in the second count, the net Accraward movement at Dodowa was 80 tons more than that at Senchi, this was again taken to be the contribution of the Assessawa area. The figure, less than 2.0 per cent of the total import into Accra, again shows the contribution of the Assessawa area to be smaller than is popularly supposed. Its principal function is to supply Koforidua and the densely-peopled rural areas around.

Here it must be noted that many of these contributions of one area to the food supply of another may be indirect. Thus, 209 tons of maize and 278 tons of yam crossed Senchi, but only 129 tons of the former and 226 of the latter passed Dodowa. At the same time, no plantain or cocoyam crossed Senchi, but 221 tons passed Dodowa. Thus, yam and grain move from beyond Senchi to Assessawa and forest products move from thence to Accra. These indirect contributions can, however, be safely measured, for these staples are essentially bulky and starchy and can be compared on a ton for ton basis.

SUMMARY AND CONCLUSIONS

It remains to sum up. While there is adequate source material for investigating the more highly-organized external exchange, and while individual studies of local exchange are increasing, the economic geographer in Intertropical Africa is faced with a dearth of quantitative information on the internal exchange economy. Hence, full use must be made of the few available sources, such as the checks on truck loadings, which exist in the Gold Coast. The temptation is to read too much into statistics which are admittedly incomplete and not wholly reliable, a temptation to which the present writer cannot be wholly absolved from succumbing. The material must be used with caution and supported at every point by adequate field work.

Certainly, the study of internal ex-

[9] "Movement of Local Food," Office of the Government Statistician, Accra, 1953, p. 11.

change is proper to a full analysis of a rapidly expanding economy such as that of the Gold Coast. Despite considerable progress, food production still absorbs most of the economic effort. Thus, the release of labor for use in other activities depends on decreasing the proportion of that engaged in subsistence agriculture. Without this, further specialization in employment is impossible.

The importance of this is further emphasized by the fact that if cacao be regarded as a raw material and not as a food the Gold Coast is a net importer of food. This import is not only of luxury foods and of staples such as wheat flour which cannot be produced locally, but of local staples as well. In 1953, 11,700 tons of fish, 3570 tons of rice and corn, 21,000 tons of sugar, 64,514 head of cattle, and 244,473 head of sheep and goats were imported.

Though there cannot be said to be a real shortage of home-produced foods, the great increase in the non-agricultural population seems temporarily to have outstripped expansion of agricultural output. There is, therefore, a need to increase the food supply. Small increases, perhaps merely greater efficiency in harvesting and storage, and greater quantities reaching the markets as a result of road building, would be reflected out of all proportion in the internal exchange system and would be adequate to sustain the non-agricultural population for some time to come. Nevertheless, food production remains a vital element in the future of the Gold Coast's economy.

SOME NOTES ON RECENT TRENDS IN RICE PRODUCTION IN CUBA*

Raymond E. Crist

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RICE (*Oryza sativa L.*) has for centuries been an important source of food for man, but when and where it first came into use as a staple food is unknown. The preparation and use of this great cereal outdates written records. Rice probably originated in southeastern Asia, whence it spread to India and Persia. It became known in Europe as a result of the campaigns of Alexander the Great. It was introduced into the Nile delta by the Arabs and into Spain by the Moors. Shortly after the Conquest, the Spaniards introduced it into the Caribbean Basin, and the Portuguese introduced it into Brazil. Of course, wild rice (*zizania aquatica L.*), indigenous to the Americas and to other areas of the world, was known to the New World Indians long before the arrival of the Europeans, and had been a staple food for centuries. But it was never domesticated, and was at once superseded in importance by the cultivated variety introduced by the Europeans.

It is difficult to say in just what year the Spaniards introduced rice to the New World. It is possible that Columbus brought seeds on his second voyage. His fleet of 17 vessels arrived in Hispaniola on November 22, 1493. But there was very little interisland trade in those days. As for Cuba, we read in a dispatch quoted by Llaverias:

"I have been informed (December 10, 1512) that it would be advantageous to attempt to plant rice in this island (of Cuba) and in that of San Juan (Puerto Rico) . . . and I have accordingly requested from the officials in Seville that they send seed so it can be raised there."[1]

Spanish, French, English, and Dutch travellers, many of them remarkable observers and writers, were for the most part interested in the money crops grown in the New World rather than in the foodstuffs of the lowly slaves whose labor produced the money crops. Hence, an exhaustive survey of the literature fails to reveal more than occasional references to rice, in spite of its growing importance in the diet, in the Antilles in general and in Cuba in particular. Precise statistics are unavailable, but it is estimated that per capita consumption a century ago was 40 pounds annually, of which some 20 pounds were grown on the island. During the last ten years the per capita consumption of the grain has been 110 pounds, of which 90

*Some very interesting articles on rice growing in Cuba appeared in El Mundo for February 23, 26, and 28, 1954 by Professor Levi Marrero. The helpful suggestions of Dr. Carlos E. Chardon, Technical Consultant, Puerto Rican Land Authority, and of Professor Albert Muller and Mr. John Van Dyke Saunders, University of Florida, are gratefully acknowledged. The writer wishes to acknowledge, too, the assistance of the Guggenheim Foundation in making possible the field work in the rice areas.

[1] Joaquin Llaverias: *Papeles en el Archivo General de Indias*, Vol. I, La Habana: Imprenta el Siglo XX, p. 4.

pounds were imported. Indeed, the imports of rice have cost more each year—a total of $43,500,000—than the value of the entire tobacco crop, which was $35,000,000.

The Cuban does not eat as much rice as the Asiatic, who consumes some 300 pounds a year. But the Asiatic has very little else, whereas the Cuban has an extremely varied diet to choose from, including items made of wheat, which usually exclude the use of rice. Many reasons why Cubans prefer rice are brought forward. Rice keeps better than wheat in a humid climate; it is easier and simpler to boil rice than to bake bread, and so on. It doubtless assumed even greater importance in the diet with the importation into Cuba of thousands of Chinese, accustomed to eating much rice; many of them became cooks and thus made the eating of rice even more popular. Whatever the reason, or reasons, rice became and continues to be a staple in the Cuban diet, and the proportion of imported over domestically produced rice increased with the growth of population and the emphasis on the raising of sugar cane. In 1928, just before the Great Depression, the per capita consumption was 138 pounds, of which only 11 pounds were domestically produced—a truly anomalous situation of a high per capita consumption of an imported foodstuff in an agricultural country which lives from exporting agricultural products. But this anomaly is being rapidly whittled down. The growing of rice has experienced a phenomenal expansion. It is a recent, dynamic element which is making itself felt in many sectors of the national economy.

Cubans have for generations preferred to cultivate dry or upland rice rather than the wet rice which must grow in irrigated fields, breeders of the malarial mosquitoes. But the uncertainty of rains in the dry rice sectors, and the small areas planted, made it impossible to achieve commercial production of upland rice. Each year small plots of dry rice, called "arroz de la tierra," were grown around the farmsteads for domestic use, and this was hulled by hand in the immemorial pilón—the mortar hewn out of a section of log about three feet long.

As the demand for rice increased it was filled more and more by supplies from the Orient. It was possible to grow it in Asia, transport it to Europe and mill it in Liverpool or Bremen, and import it into Cuba at prices with which the Cuban farmer could not compete. Even as late as 1937 rice from the Orient was sold in Havana for 2 cents a pound.

Changes Since World War II

The second world war changed the entire rice picture. International trade was interrupted, Cuba began to depend almost entirely on the United States for its rice, and the price in Cuba increased many fold.

With the cessation of hostilities, rice from the Orient did not begin to flow along its former channels. Asia now needed all of its own production.

In this post war period, the economic climate for rice production was so favorable in Cuba that the Cubans could begin to compete with the producers of the United States. In so doing they have copied the methods of the rice growers in Louisiana and Texas rather than those of the Oriental coolie.

In Cuba, production costs for mechanized cultivation were high, but prices for the product were also high, making big profits possible; the Cubans had learned their lesson of mechanization well, and they now used with dexterity the new flexible instruments of quotas and customs duties.

The great grassy plains of Cuba were

FIG. 1 (upper left). A field of *arroz secano* (rice grown without irrigation) sown broadcast by hand in a plot from which the *barrigona* (big-bellied) palms have not been cleared by the small farmer.

FIG. 2 (upper right). An extensive field of dry rice near Herrandura. This is worked entirely by machinery.

FIG. 3 (lower left). Pump house and irrigation ditches on rice plantation. Characteristic features of the modern, mechanized neo-plantation.

FIG. 4 (lower right). Extensive fields of irrigated rice on cleared savanna, that spatially are suggestive of plantation morphology.

called savannas by the Tainos, the pre-Conquest Indians. The savanna was not popular with those who wanted to farm. The word has frequently been synonymous with land held to be almost worthless, or at best fit only for pasturing a few scrawny head of livestock. Savanna land was extremely cheap, and was often held in enormous tracts, if it was to be valorized at all. Fortunately, many savannas are underlain by water-bearing strata lying only 40 or 50 feet below the surface. The result is that much savanna land, only recently considered to be almost worthless, has in a few years time increased in value a hundred fold, or even more.[2] This modern miracle is the result of the coaction and interaction of a number of different factors at precisely the right moment in history. The most important technical item in this set of cultural and physical factors is the internal combustion motor, attached to pumps, combines, jeeps and planes.

Depending on the point of view, Cuba has had the fortune or the misfortune to have exceptional advantages for the production of sugar. It has proved a bonanza to cultivate cane on some of the best soils in the world with very primitive methods. The industrial phases of the sugar industry are so up-to-

[2] Raymond E. Crist: "Western Cuba: Cultural Traverses in Time and Space," *The Scientific Monthly*, Vol. 74, No. 2, February, 1952, pp. 93–96.

date and modernized that the industry can compete favorably with other sugar producing countries, but small scale agriculture, generally speaking, has lagged behind. The Cuban small farmer in particular has not been able to get out of his rut, because he did not have a good example to use as a goal. Only occasional isolated examples of good farming practices confirmed the general rule.

A TECHNOLOGICAL REVOLUTION

On the other hand, if rice is to become a commercial crop revolutionary methods of production must be introduced. To be sure, rice produced in the traditional rice growing areas is grown by traditional methods, but most of the new producing areas, almost exclusively on savanna soils, are highly mechanized. Bulldozers are used to clear the land of the natural vegetation of brush and big-bellied palms, and are followed by tractors pulling gang plows; then the fields are leveled off by the use of a mechanical leveler, and they are ready for the irrigation canals through which water, pumped from wells or a near-by river, flows to the fields. Then planes are used to plant the seed and later on to scatter the fertilizer and spray for pests.

As soon as the crop is ripe it is harvested by giant combine harvesters. The grain, hardly touched by human hands, is mechanically dried and hulled in enormous warehouses and mills.

It is quite obvious that modern rice production requires tremendous outlays of capital. Perhaps cooperatives will evolve that will make it possible for the small farmer to participate to some extent in this bonanza. To date only the large landowner, and those with much investment capital, have been able to enter the field.

For instance, over 60 per cent of the

FIG. 5. A flagman for a plane which is sprinkling insecticide on growing rice.

15,000 tractors imported by Cuba from 1946 to the present are at work in the rice areas. The tractor drivers now earning high wages are the same young men who, only a few years ago, were behind a yoke of oxen, earning very low wages. However, fewer tractor drivers are required at present than ox-drivers then. This is symptomatic. The large mechanized rice plantations will not be areas on which great numbers of small landholders will make a modest living. Migration to the cities, into industry, will be the lot of many of the young farm people of today.

After a visit to his rice fields in the vicinity of Herradura, my host shared my amazement at the great changes witnessed in the landscape, saying that it is easier now to see an airplane than a horse in that area. Only shortly afterward a small plane came over a nearby field spreading chemical fertilizer. The flagman on the ground who guided the pilot was a typical Cuban country lad who a few years ago would have been employed in a much more prosaic task.

EXPANSION OF RICE GROWING ON SAVANNA SOILS

Rice cultivation is being extended in many areas, irrespective of the nature of the soils. The vast development around Manzanillo has been effected

in the main on two types of soil, described by Bennett and Allison as (a) "black savanna clay over very stiff clay, mostly unfavorable soil"; and (b) "clay, generally in need of ditching. Considerable unfavorable soil; some good."[3]

The rice produced in the area of La Florida, a few miles west of Camaguey, is grown on "mainly sandy savanna soils, with scattered patches of clays and other good soils. The better grades of these soils can be farmed with heavy fertilization."[4]

The vast extensions of the rice producing areas in the vicinity of Herradura and Consolación del Sur have been made on "sandy and silty coastal flats of a savanna nature. Basal heavy, mottled clay often near surface. Much very poorly drained, acid soil of low productivity, especially near the coast. In upper part and along some streams deeper and better drained soil is found, much of which produces tobacco and good vegetables with liberal fertilization."[5]

It is on such soils, formerly considered almost worthless, that rice plantations are being developed. Thus rice does not compete for land with sugar cane or tobacco, the great commercial crops of the island.

CONCLUDING REMARKS

The favorable economic climate for rice growers is due largely to the liberal credit policy of the Banco de fomento Agricola e Industrial de Cuba (Banfaic), which announced on July 3, 1953, that, during the year ending June 30, 1953, the bank, mostly through Rural Credit Associations, had lent $6,208,254.52 to rice growers. The bank stated that approximately 1,053,460 quintales of rice were produced under the stimulus of these loans. Prices of land on which rice could be grown have risen accordingly. In 1953 Guillermo Aguilera Sanchez bought, for $750,000, seventeen hundred caballerias of land which up to three years previously had not been considered worth fencing. This represents somewhat more than a tenfold increase in land values.

It has been noted that in several widely separated sectors of Cuba soils that only a few years ago were considered poor to worthless are being used for the production of rice. These producing areas, in which the natural landscape has remained unchanged for millenia, are undergoing a rapid transformation. The rapidly evolving cultural landscape in these sectors is due almost entirely to the favorable economic climate induced by the high price of rice.

Although the consumption of wheat has decreased in the traditional wheat bread eating countries, due to the increased use of "protective foods," the consumption of rice in the world increases steadily and world production of that grain is greater than that of wheat. The grower of rice is almost always sure of a crop because pests and serious diseases are few. Rice is a concentrated form of relatively cheap calories, that keeps well and can be easily shipped; it is easily digested and is what might be called neutral in flavor; hence the person accustomed from childhood to consuming rice never seems to tire of eating it. Millions of people of the world practically live on rice alone and are glad indeed if they can obtain each day the few grains of rice necessary to keep body and soul together.

Since many tropical lowland soils can be used for crop production, they will have to be pressed into service as the number of mouths to be fed increases. Fortunately, many of the

[3] From soil map accompanying Bennett and Allison's "The Soils of Cuba," Washington, D.C., 1928.
[4] *Ibid.*
[5] *Ibid.*

principles of agronomy which apply to the usual grain crops do not seem to apply to wet or irrigated rice. Even when a soil is too infertile to produce any other grain crop it will produce some rice if it is well puddled and if the crop can have a few inches of water standing on it throughout the growing season. Lowland rice is the most effective food crop which can be grown on many very poor tropical soils, because it is adapted to wet soils and because even on extremely poor soils it still produces some foodstuffs. Soils of mediocre fertility, which can produce reasonable yields of upland grain crops, if planted to lowland rice, flooded, irrigated, and weeded, can produce about a quarter more of rice grain than of any other grain crops, according to J. Lossing Buck, as quoted by Professor Robert Pendleton.[6] Hence it seems inevitable that more and more people of the world, especially those living within the tropics, will have rice as their basic foodstuff.

[6] Robert L. Pendleton: "The Place of Soils in Feeding the World," *CEIBA*, Vol. 4, No. 4, p. 221 (Escuela Agricola Panamericana).

USE OF INDIRECT BENEFIT ANALYSIS IN ESTABLISHING REPAYMENT RESPONSIBILITY FOR IRRIGATION PROJECTS

M. E. Marts

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ONE of the major factors responsible for settlement in the western United States has been irrigation. The area-development aspects of irrigation are widely recognized, but the problems confronting further expansion of irrigation are much less widely understood, even in irrigated areas. These problems stem from the disparity between the rapidly increasing costs of modern irrigation projects and the ability of the project farmers to repay those costs. The increased costs are partially attributable to the long-range upward trend in the costs of materials and labor. More basic are the increased physical problems of bringing water to the remaining undeveloped lands.

In its comprehensive report, prepared in 1950, the President's Water Resources Policy Commission acknowledged the contribution made by irrigation developments in the past and stressed the desirability of reclaiming additional arid lands. To close the gap between project costs and the payment ability of the farmers, the Commission recommended that local interests who benefit indirectly from irrigation projects should repay a share of the costs proportional to the benefits received.[1] In reality this is a logical extension of the conservancy district concept, which has been applied to irrigation projects only in a few instances.

It has long been recognized that the farmers—the direct beneficiaries—are not the only beneficiaries of irrigation projects. From even the most casual observation of urban growth and other evidence of economic activity in irrigated areas, it is obvious that important benefits accrue indirectly to nonfarm segments of the population. The fact that the benefits accrue indirectly does not make them any less real. It seems only equitable that these indirect beneficiaries be assessed, along with the direct beneficiaries, for a fair share of the project costs.

A consideration of the problems involved in applying the recommendation of the Water Resources Policy Commission, however, underscores the inadequacy of present procedures for economic appraisal of irrigation projects. It is especially in the field of the indirect benefits (which may be either positive or negative) that information and techniques have been deficient. The direct benefits have received much systematic study in the past, and can be estimated within a reasonable margin

[1] *A Water Policy for the American People*, Vol. 1 of the report of the President's Water Resources Policy Commission, Government Printing Office, Washington, 1950, p. 81.

of error. The estimation of indirect benefits constitutes one of the most complex current problems in the economics of resource development. The determination of indirect benefits would be crucial in establishing rational payment requirements for indirect beneficiaries, as recommended by the Commission. It is, therefore, desirable to review briefly the progress which has been made in measuring the indirect benefits and to suggest avenues of further exploration.

TECHNIQUES OF INDIRECT BENEFIT MEASUREMENT

The United States Bureau of Reclamation, the governmental agency having the major responsibility for irrigation developments, has been especially interested in indirect benefits, although for purposes of project justification rather than assessment of costs, and has experimented in recent years with several methods of measuring such benefits.

Prior to 1947, the Bureau of Reclamation used two methods of suggesting the magnitude of indirect benefits. One method used readily obtainable indices of social and economic activity within irrigated areas such as school attendance, bank clearings, carlot shipments, and tax collections. The other method recognized the increase in the gross value of the crops produced on an irrigation project as a measure of the total benefits—both direct and indirect—of the project. This method assumes that the farmer spends all his income, and that what are costs to the farmer accrue as benefits at some other level of the economy.

Since 1947, the Bureau of Reclamation has used procedures which attempt to estimate the appropriate share of the increment to national income attributable to the irrigation project under consideration.[2] Much difficulty has been experienced in defining "appropriate share." One procedure used for a time recognized the total increment to national income as a benefit; another procedure recognized only the profit component, excluding interest and labor income. Later a compromise procedure was developed which recognized a part of the interest and labor income as well as the profit component as benefits. No single technique has gained general acceptance either within or outside the Bureau.

The Bureau, recognizing the inadequacy of its theoretical procedures, has from time to time sponsored special studies in order to develop empirical information with which to test procedures. These studies have sought to measure benefits as they have actually accrued within irrigated areas. A study released in 1947 sought to indicate the extent of the indirect benefits in the Twin Falls area—a representative irrigated district of southern Idaho. By contrasting the amount of economic development in 1900 with that in 1940, an estimate of the increased wealth attributable to irrigation was developed in terms of gross income, employment, and capital investment.[3] The data do not lend themselves to summarization in a form which would be useful in preparing other benefit estimates, however, and such summarization was not attempted.

F. E. Schmitt, studying the question of payments from indirect beneficiaries of the Central Valley Project in California, attempted to determine the quantitative relationship between direct and indirect benefits by using population

[2] U. S. Bureau of Reclamation: *Reclamation Manual*, Vol. XIII, *Benefits and Costs*, Dept. of the Interior, Washington, 1947, Part 2. (Multilithed; for administrative use only.)

[3] *The Columbia River Basin Report*, Bur. of Reclamation, 1947, pp. 77–81.

data.[4] He reasoned that population distribution constituted "a closely approximate measure of income distribution." Using this assumption, he determined the ratio of farm to nonfarm population in several representative irrigation farming counties to be within the range of 1.00–1.25 to 1.00–1.00. Schmitt contended that the "farm and nonfarm segments of an agricultural community stand in competitive relations to each other" and that, therefore, in the long run "the effective per-capita incomes of the two groups are closely equal." Thus he concluded that a 1.00 to 1.00 ratio (the lower limit of his range) satisfactorily expresses the relationship between direct and local indirect benefits. Schmitt's assumptions, of course, may be questioned. However, a factor expressing indirect benefits in relation to direct, such as he suggests, if valid, would greatly facilitate the estimation of indirect benefits because of the relative practicability of estimating direct benefits.

Other studies have shown the importance of local indirect benefits by such techniques as correlating the population increase of urban centers with the development of economically tributary irrigation projects.

The writer undertook, in 1947, to measure the relationship between the direct and indirect benefits within a local trading area dependent on irrigation agriculture.[5] This study represented the most detailed case study of irrigation benefits hitherto attempted, and has served as a pattern for a series of subsequent studies.

THE PAYETTE STUDY

In the area analyzed by the writer, the indirect benefits were found to exceed the direct benefits in the ratio of 1.27 to 1.00. In other words, for each $1.00 of net income received by farmers, net income in the amount of $1.27 accrued elsewhere within the local economy. For purposes of the study, net income was assumed to represent benefits, the objective being the relationship between farm and nonfarm income rather than absolute amounts.

The Investigational Area.—The area investigated was the town of Payette, in southwestern Idaho, and its surrounding retail trade area. The Payette area was selected for several reasons. Most important is that irrigation agriculture is its only basic industry. Because of aridity, neither dry farming nor year-round range livestock grazing can be carried on. There are no significant timber, mineral, fishery, or scenic resources. Without irrigation there would be no population present except perhaps a few people engaged in railroad and highway maintenance. Thus the Payette area meets the basic requirement of the study: that, practically speaking, all population present and all income derived within the area may be attributed to irrigation.

The trading area was delimited on the basis of the shopping habits of the surrounding farm population. The boundary, established by analyzing traffic flow data and conducting farm interviews, was a line within which the farm population did more than 50 per cent of its trading, in terms of dollar volume, in Payette or the two smaller associated towns.

The area includes approximately 55,000 acres of improved irrigated land. Its climate is typical of the arid inter-

[4] F. E. Schmitt, "Minority Report on Problem 12—Payments toward the Cost of the Central Valley Project by Indirect Beneficiaries," U. S. Bureau of Reclamation, *Central Valley Project Studies—Problems 10 to 13*, Government Printing Office, Washington, 1949.

[5] M. E. Marts: *An Experiment in the Measurement of the Indirect Benefits of Irrigation*—Payette, Idaho, U. S. Bureau of Reclamation (Region 1), Boise, Idaho, 1950.

mountain region, characterized by hot, sunny summers, moderately cold winters, and scant precipitation. The soils are extremely varied, but most are excellent, producing good yields of alfalfa, apples, prunes, potatoes, sugar beets, small grains, and truck crops. The 1940 population was approximately 11,000, of which 6700 were classed as nonfarm population and 4300 as farm population.

As noted earlier, the area supports no primary activity other than irrigation agriculture. Therefore, the contribution to national income which accrues locally was assumed to comprise the local monetary benefits of irrigation. As used in this study, benefits included net income of proprietors, wages and salaries, interest, net rents, royalties, dividends, and government payments to farmers. In the case of entrepreneurial income, net income was considered as the residual after deducting operating expenses but not taxes or personal exemptions. Royalties and interest were considered to be net. Maintenance costs were deducted in estimating net rents. In the case of wages, the total payroll was classed as net income, although it is recognized that labor has certain expenses incident to employment. These interpretations are generally consistent with those used in estimating national income.

Direct Benefits.—The direct benefits comprised three types of income: (1) net income to farm operators, (2) government payments to farmers, and (3) farm wages.

The net income to farm operators was estimated at $3,350,000 by calculating gross farm income from census data and applying a factor developed from representative farm management studies which expresses net farm income as a percentage of gross. Government payments to farmers, made under the sugar beet, dairy, beef, sheep and lamb, and agricultural conservation programs, amounted to $333,000. Farm wages, estimated from census data, amounted to $952,000. Summarizing, the direct benefits totalled $4,635,000.

Indirect Benefits.—The indirect benefits, defined in the study as including all net nonfarm income, also comprised three types of income: (1) net entrepreneurial income, (2) labor income, and (3) property income. The first two types were estimated from data collected in the course of a field investigation, the third from published statistical data.

The crux of the study was the collection, in the course of the field investigation, of net income and payroll data from a satisfactory sample of the local business establishments. The field investigation made use of a simple questionnaire, keyed to income tax forms. The collection from a fairly large sample of businesses of net income statistics, invariably regarded by businessmen as extremely confidential, represents a major contribution of this study to the general problem of local-area economics. Without success in this phase of the investigation, the estimation of the net income of the trade area would have been extremely difficult, if not impossible. Data were collected from 125 businesses—a 36 per cent sample. The sample data were projected to a universe which was developed primarily from the list of commercial accounts of the local power company. Considerable judgment necessarily had to be exercised in projecting the sample data. The controlling factor was the number of employees, for which the most complete data were available. The net entrepreneurial income, estimated in this manner, amounted to $2,405,000—an average of nearly $7000 per business establishment.

The total income of nonagricultural salary and wage earners was estimated in the same general manner at $3,071,000 (an average of $1836 per employee).

Property income—net rents, royalties, dividends, and interest—was estimated at $415,000. This estimate was based on property income as reported in Survey of *Current Business* for the state of Idaho, adjusted to the trade area.

The local indirect benefits, comprising the foregoing items, thus totalled $5,891,000.

Indirect Benefit Ratio.—The ratio of the indirect to the direct benefits, as noted previously, amounted to 1.27 to 1.00. The sum of these values, 2.27, may be considered as the local economic multiplier. This study, of course, covered only one community and one year (1946). The income data undoubtedly vary from year to year, with changes in general business conditions, but it may well be that the multiplier relationship is rather conservative.

The indirect benefit ratio of 1.27 found in the Payette study roughly supports Schmitt, who, as noted earlier, found an indirect benefit ratio ranging from unity to 1.25.

Although the Payette findings are not directly comparable with the data developed in the Twin Falls study, previously mentioned, certain relationships can be found in the latter which invite comparison. Thus a rough "indirect benefit ratio" developed from somewhat incomplete data on capital investment in the Twin Falls area is 1.20. Based on population, the indirect benefit ratio would be 1.10. Dollar volume of business transactions, however, yields a ratio of 2.0, considerably higher than any of the other ratios noted including that developed for Payette.

On the basis of the Payette findings, the gross crop value method of estimating total benefits, discussed earlier, appears overly conservative. The gross crop value estimated for the Payette area ($4,800,000) amounted to only 46 per cent of the sum of the direct and indirect benefits ($10,526,000).

SUBSEQUENT PAYETTE-TYPE STUDIES

Several similar studies have been carried out subsequent to the original Payette study. Five of these were conducted by various offices of the Bureau of Reclamation in response to a request from the Washington office for analyses similar to the Payette investigation.[6] The findings tend to corroborate the Payette results. In two of the studies, Weld County, Colorado, and Newlands Project, Nevada, ratios of 1.29 and 1.20, respectively, were found. These findings are remarkably close to the Payette ratio of 1.27. A third study, of the Klamath Project (Oregon and California), measured the relationship between all basic income (rather than simply irrigation agriculture) and income of other (secondary and service, or tertiary) activities. Although this approach differs somewhat from the Payette study, the resulting ratio of 1.12 is close enough to cast no doubt on the other findings.

Only two of the studies developed factors differing significantly from the range of results mentioned previously. Both exceeded the range. The ratio found for the Yuma and Gila projects,

[6] These studies, all by the Bureau of Reclamation, are: "Accomplishments of Irrigation, Weld County, Colorado" (Region 7, Denver, 1952). "An Evaluation of the Effect of the Carlsbad Irrigation Project on the Local and National Economy" (Region 5, Amarillo, 1951). "Evaluation of Local Irrigation Accomplishments, Yuma and Gila Projects Trade Area, Arizona-California" (Region 3, Boulder City, 1951). "Reclamation Accomplishments, Klamath Project, Oregon-California" (Region 2, Sacramento, 1952). "Evaluation of Irrigation Accomplishments, Newlands Project Trade Area, Nevada" (Region 4, Salt Lake City, 1952).

taken together, was 1.74. This relatively high ratio may conceivably be explained by the intensive character of the agriculture in the Yuma area, with its emphasis on high-return, off-season cash crops. It seems reasonable to expect the indirect benefit ratio to be higher in an area of intensive agriculture.

The fifth study, covering the Carlsbad, New Mexico, Project, was carried out with different assumptions and procedures, and is therefore not comparable with the others. It develops estimates from which a ratio of 2.90 may be derived, but the lack of comparability precludes relating this to the other findings.

In a study of Twin Falls County, Idaho, Luntey found an indirect benefit ratio of 1.29 using the same concepts and approach as the original Payette study but independent of Bureau of Reclamation or other institutional sponsorship.[7]

Summarizing the findings of these studies, with the exception of the noncomparable Carlsbad study, we have the following array of indirect benefit ratios: Klamath, 1.12; Newlands, 1.20; Payette, 1.27; Twin Falls, 1.29; Weld County, 1.29; and Yuma-Gila, 1.74. The grouping of four of these ratios, between 1.20 and 1.30, is striking. The four studies each considered an area with distinctive characteristics and conditions of irrigation agriculture. The small range among these results seems even more remarkable because the studies covered different years, dealt with areas of different agricultural types and intensity, and had recourse to various kinds of statistical data. These results suggest with considerable force that a local indirect benefit factor of 1.20 may, within reasonable tolerance limits, be valid and even, perhaps, slightly conservative.

[7] Harold G. Luntey: *An Analysis of the Economic Benefits of Irrigation to Twin Falls County, Idaho*, Unpublished Master's thesis in geography, University of Washington, Seattle, 1953.

APPLICATION

It now remains to consider the meaningfulness of such benefit factors as a basis for decision making. The avowed purpose of most benefit estimates has been project justification. Inasmuch as federal irrigation developments enjoy availability of capital from the national level at very attractive terms (i.e., with elements of subsidy), project justification inevitably involves consideration of national benefits and costs. The validity of local impact estimates must be tested in the light of two basic assumptions, which appear reasonable: (1) that indirect effects are more obvious and hence easier to trace at the local rather than the national level, and (2) that whereas the major share of indirect benefits accrue locally, the major portion of indirect costs are national rather than local in their incidence. If these assumptions are correct, and they appear reasonable, the benefit factors derived in the studies discussed above, which do not include considerations of nation-wide impacts or relative efficiency of investment, can be used only with many reservations, if at all, for justifying national investment.[8]

The allocation of repayment respon-

[8] The Federal Inter-Agency River Basin Committee's subcommittee on benefits and costs summarized its position on this point thus: "Ascertaining and measuring net secondary [i.e., indirect] benefits properly creditable to a project is a most difficult and complex problem and care must be exercised in their use for project justification. Because of such difficulties, primary reliance in project analysis will usually need to be placed on the more direct types of project effects." *Proposed Practices for Economic Analysis of River Basin Projects*, Federal Inter-Agency River Basin Committee, Subcommittee on Benefits and Costs, Washington, May 1950, p. 11.

(*Continued on next page*)

sibility between classes of beneficiaries within the local area, however, does not necessarily require the determination of net national impacts.[9] Sufficient for this purpose is the determination of the incidence and relative magnitude of the local benefits only. The indirect benefit factor determinations discussed above appear to offer a method of making such determinations, and thus of implementing the recommendation of the Water Resources Policy Commission. In this sense, indirect benefit measurement at the local and hence relatively realistic level has both validity and utility. Adequate techniques, therefore, appear available, at least to provide data as a basis for negotiations, to implement the Commission's recommendation in a rational manner.

Ransmeier, in his study of the economics of planning in the Tennessee Valley Authority, concluded that "the difficulties of achieving reasonably accurate appraisals of prospective benefits are so great that we question whether it is possible to formulate a program of water resource development according to strict benefit-cost relations. We believe the effort is doomed to fail. In the end social considerations and public policy rather than hypothetical benefit valuations will be found to provide the more honest and satisfactory guides for public water planning." Joseph S. Ransmeier: *The Tennessee Valley Authority*, Nashville, 1942, p. 421.

[9] An exception would be a business operating over a wide area as well as locally (e.g., a railroad) whose revenues might increase locally but decrease elsewhere with project development.

THE SMALL HIGHWAY BUSINESS ON U.S. 30 IN NEBRASKA

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THE modern transcontinental highway is associated with a complex social system which in all of its ramifications orders a rich and distinctive culture. In the United States the highway complex is a matter of such intense concern at local, state, regional, and national levels that there is general acceptance of the view that highway research might yield practical results. In addition, however, the social scientist is interested in the description of a social system which together with its ordered culture is characteristic of contemporary, industrialized, and highly organized societies and which except under conditions of acculturation is not found in the more simply organized groups. The social scientific study of this modern highway complex promises to contribute to the description of our own culture and to theories of structure, function, communication, values, and cultural change.

The full description of the highway social system and its ordered culture is a massive undertaking requiring substantial research means. When such resources are lacking, it is necessary to use a series of small research designs which successively contribute to the larger research aim. In this inquiry, the first sub-study was directed toward a description of the small highway business.

From the viewpoint of field design, an investigation of the small highway business is a convenient beginning toward the study of the entire highway system and culture. It is true that the very core of the highway social system is the ever-present and ever-changing traffic flow and that ideally social scientific research might begin with an analysis of the traffic flow. Exploratory work, however, indicated that the description of the traffic flow in anthropological terms cannot be easily accomplished because of difficult problems both in method and technique. In contrast, conventional methods and techniques can be used to study the small highway business establishment at low cost. Moreover, these businesses which service and maintain the traffic flow, occupy positions of strategic importance in the total system. It is not accidental that the distinctive buildings occupied by these businesses are among the most characteristic features of the man-made highway environment. The study of the small highway business will yield data which are not only needed for an understanding of the larger system and culture, but which have descriptive value and interest in their own right.

The choice of U.S. 30 as the highway of study in Nebraska was dictated both by theoretical and practical considerations. U.S. 30 is, of course, a major

transcontinental route crossing eleven states between its eastern terminal of Atlantic City, New Jersey, and its western terminal of Astoria, Oregon. In Nebraska it is the principal east-west route and the highway with the largest traffic flow. In its 449.4 mile course across the state, this highway passes through 13 counties and many of the state's larger towns (Fig. 1). By any ordinary standard, whether geographical, economic, political, or interactional, this highway must be judged to be the most important through highway in the state.

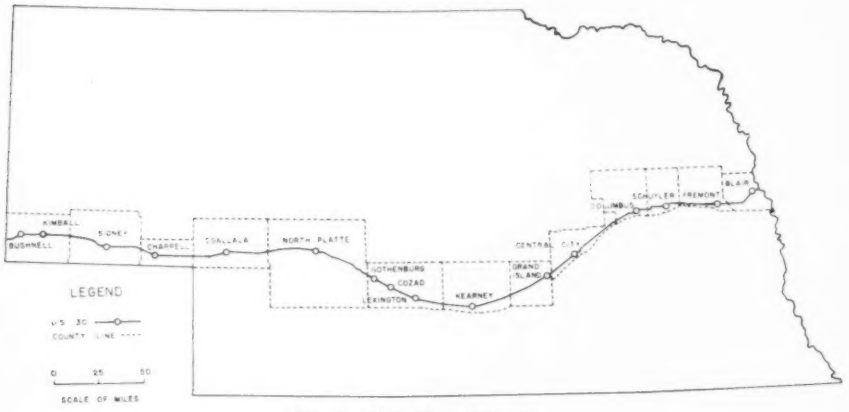

FIG. 1. U.S. 30 in Nebraska.

The present paper, then, is a first report of a social anthropological study of U.S. 30 in Nebraska. It attempts to place the small highway business establishment in its general geographical context and to summarize the results of an interviewing program conducted during 1954 with persons from a random sample of the small highway business establishments.

NEBRASKA U.S. 30

Through much of its course in Nebraska, U.S. 30 follows the Platte River valley, a natural route of historical consequence. The present highway, during part of its way through Nebraska, retraces the old Mormon Trail, used in the decades following 1847, and roughly parallels the Oregon Trail. The Pony Express followed the same general route, and it was along this route also that the tracks of the Union Pacific Railroad were finally completed in 1869.[1]

Acts passed by the Nebraska Legislature in 1869, 1871, and 1873 provided for a 64-foot strip along the section lines to be maintained as public roads by the counties.[2] The state highway program actually began in 1917, when the Legislature accepted the provisions of the Federal Road Act of 1916 and designated the State Board of Irrigation, Highways, and Drainages as the state agency to administer a cooperative state-federal program for the construction of rural roads.[3]

Local interest in a through highway was heightened by the establishment of

[1] Grenville M. Dodge: *How We Built the Union Pacific Railway*, Government Printing Office, Washington, D.C., 1910, p. 25.

[2] *General Statutes of the State of Nebraska*, compiled by Guy A. Brown, Journal Co. State Printers, Lincoln, pp. 950–960.

[3] Laws, Resolutions, and Memorials, passed by the Legislature of the State of Nebraska, at the 35th Session, Secretary of State, Lincoln, 1917, p. 420.

the famous Lincoln Highway which, as routed by the Lincoln Highway Association in 1913, followed essentially the same route as that of the present U.S. 30 and Alternate 30.[4] Unlike the modern highways, the Lincoln Highway followed the straight lines and right angles of the original section lines. In addition it had 29 dangerous grade crossings over the Union Pacific railroad.

More recently there has been a major relocation of the highway and today there are only 12 grade crossings and four spurs to be crossed. By the fall of 1928, the entire highway was surfaced with gravel except for sixty miles of graded roads and for pavement in Grand Island, Kearney, and North Platte, and between Fremont and Ames. Ten years later the highway followed its present route, and the highway between Fremont and Omaha was designated Alternate U.S. 30. The toll bridge over the Missouri River east of Blair had replaced the ferry and the entire highway was hard surfaced. Today, U.S. 30 is a two-lane hard surfaced road. Much of it is concrete, but sections are either asphalt or oiled.

U.S. 30 enters the state from the east over a toll bridge across the Missouri River, two miles northeast of Blair. Its route through Nebraska is as follows: from the bridge through Blair, to Fremont; along the north bank of the Platte River between Fremont and North Platte; along the north bank of the South Platte River between North Platte and Brule; on a straight east-west line between Brule and Chappell; and along Lodgepole Creek between Chappell and the Nebraska–Wyoming border. Of Nebraska's major topographical regions, the highway crosses the Missouri Valley lowland and the Loess Hills region, but it lies principally in the Platte Valley lowland and the Cheyenne Plain.[5]

The highway has few sharp curves or steep grades; the steepest grades are found at overpasses and bridge approaches. The gradient of most of the road is that of the Platte River—308 miles of the highway lie in or bordering the valleys of the Platte and South Platte Rivers. There is, therefore, a steady though gradual gain in elevation from east to west: the elevation at the eastern end of the highway in Nebraska is 1002 feet, and at the Wyoming line, 4986 feet.

This slope from west to east is characteristic of the terrain of the entire state, where both the eastern prairies and the western high plains slope gradually to the east, the result in part of slope wash from the Rocky Mountains deposited primarily in Tertiary times. The uplands are covered with loess, deposited during the Pleistocene, with outcroppings of formations from earlier geologic periods in many places. The river bottoms contain deposits of numerous silts and loams.

The area traversed by U.S. 30 in Nebraska varies in climate and ecology as well as in altitude. At Blair in the easternmost county the mean annual precipitation is 28.32 inches, and the growing season averages 165 days. At Kimball in the westernmost county the mean annual precipitation is 16.51 inches and the growing season averages 137 days. In the first instance the climate and ecology are characteristic of the eastern prairies and in the latter, of the western high plains. There is, of course, a gradual transition between these two areas. The annual average rainfall, for example, near the one

[4] Lincoln Highway Association: *The Lincoln Highway*, Dodd, Mead, and Co., New York, 1935, p. 61ff.

[5] G. E. Condra: *The Nebraska Conservation and Soil Survey*, Bulletin 15, Lincoln, 1920.

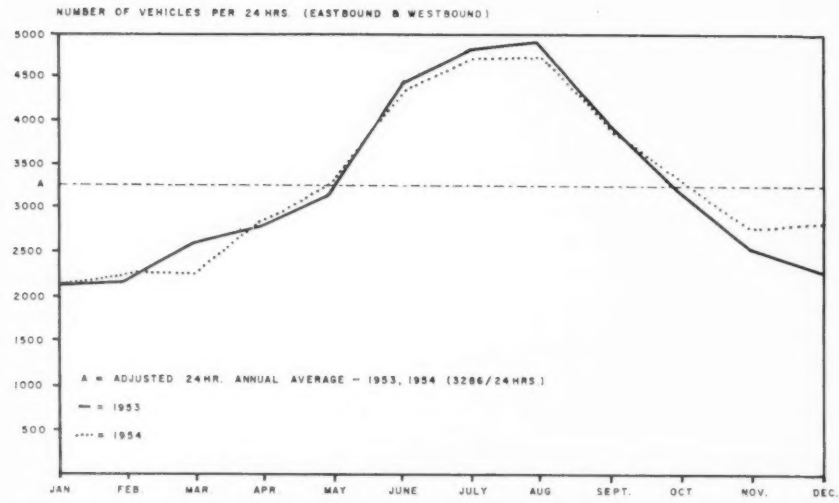

FIG. 2. Traffic flow at station 520, near Elm Creek (between Kearney and Lexington), by months in 1953 and 1954. Based on data obtained from the Nebraska Department of Roads and Irrigation.

hundredth meridian at Cozad approximates 20 inches.[6]

THE LOCAL POPULATION

Broadly speaking, population in the areas served by the highway varies in density from east to west as the region becomes less favorable to agriculture, particularly dry farming. The mid point on U.S. 30 in Nebraska is in Dawson County, just west of Cozad. The population of the 24 cities and incorporated villages located along the eastern half of U.S. 30 is 81,388, while on the western half the sixteen cities and incorporated villages have a total population of 42,075. The counties traversed by the highway vary in population density from 18.9 to 59.6 persons per square mile in the east, and from 4.5 to 10.9 persons per square mile in the west. The largest town on the highway, Grand Island, with a population of 22,682, is in the east. The largest town on the western half is North Platte, with a population of 14,433. Moreover, the eastern half has four additional towns with populations of more than five thousand, while only one additional town approximates this figure in the west.[7]

The important relationship of the highway system to these local communities must be considered elsewhere. To a considerable extent the small highway business is supported by these communities, but it will be seen that neither the traffic flow nor the number of small highway businesses vary as directly with changes in climate and ecology as does the general population of the area.

TRAFFIC FLOW

The core of the intricate social structure associated with the modern highway is the traffic flow. Although it is not possible to describe the flow on U.S.

[6] *Climate of the States: Nebraska*, United States Government Printing Office, Washington, D.C., 1941; *Climatological Data: Nebraska, Annual Summary, 1953*, Volume LVIII, No. 13, Kansas City, 1954.

[7] *U. S. Census of Population, 1950*, Vol. II, Part 27, United States Government Printing Office, Washington, D.C., 1950, p. 19ff.

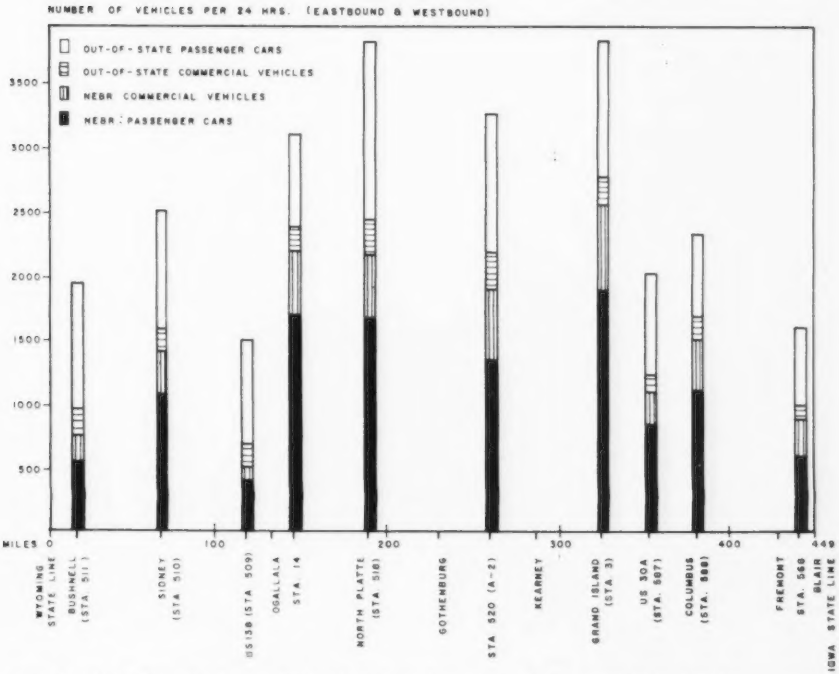

FIG. 3. U.S. 30 traffic flow in 1953. Based on data obtained from the Nebraska Department of Roads and Irrigation.

30 in detail, some of its essential dimensions must be described before the small highway business can be discussed.

Figure 2 presents data on the U.S. 30 traffic flow as recorded during 1953, the year previous to the field investigation, and during 1954. It can be shown that the changes in traffic flow between the two years is not statistically significant in relation to the general picture. What change is significant to the small highway business is not known. It will be noted that the traffic flow varies, of course, with the season of the year. The traffic volume exceeds the 24-hour annual averages only during the months of June, July, August, and September. Much of this sharp increase is caused by through tourist traffic which is characteristically heavier during the summer months.

Figure 3 represents traffic flow during 1953 based on manual counts made by the Nebraska Department of Roads and Irrigation at the points shown in the figure. Such counts are made during different eight-hour periods on from four to 11 days, depending on the station. Such counts are then adjusted by that department to a 24-hour annual average basis, and show all the different kinds of vehicles passing the given station. These counts have been accumulated to show in Figure 3 only: Nebraska passenger cars, Nebraska commercial vehicles, out-of-state commercial vehicles, and out-of-state passenger cars. The total length of each bar gives the 24-hour adjusted annual traffic flow in both directions at each station.

At each end of the highway there is some out-of-state traffic which is essen-

tially local and some Nebraska traffic which is more like the out-of-state traffic, but in the main the through traffic is represented by the out-of-state vehicles. It will be noticed that the greatest traffic flow is in the center of the state. In the east, traffic is diverted by Alternate U.S. 30 through Omaha, and in the west, by U.S. 138 to Denver. All streams, however, flow along the center section of the highway.

This brief analysis shows that the traffic flow on U.S. 30 in Nebraska varies in several different ways. The traffic flow, of course, has other properties. As a matter of fact, the habits of the businessman and the habits of individuals in the flow, whether they be local drivers, passengers in a bus, visitors from the next county, truckers, or a traveling family group, are in adjustment. Some aspects of this interaction will be discussed in following sections.

THE SMALL HIGHWAY BUSINESS

It is a commonplace that many of today's retail businesses are dependent in varying degrees on the automobile-borne customer. In the towns along U.S. 30 the ubiquitous parking meter, the parking lot, and the crowded streets attest to the volume of such trade. Many of these customers are from the immediate area, but any establishment in any town or village on U.S. 30 is easily accessible to the customer who is also a through traveler on the highway. Certainly, the highway trade is of some moment to the general business community in each of these towns and villages.

Since resources were not available for the study of all of the establishments catering to the traffic flow, it was necessary to limit the universe of study. First, the inquiry was limited to businesses servicing and supplying the through passenger traffic. It was thought that this traffic and its supporting businesses were particularly distinctive of the highway social system and culture. Second, only those business establishments with frontages on U.S. 30 were considered. Admittedly, establishments away from the highway are also important to the through traveler, but such establishments usually are more "local" than "highway" in character. Since the structures occupied by highway establishments are an integral part of the highway environment and since they are highly visible to highway customers, it was thought that such businesses are most likely to be patronized by customers from the through traffic stream. Even these businesses, however, were too numerous to be studied in their entirety. They simply constituted a universe from which a sample could be drawn.[8]

The Census

Early in July, 1954, a count was made of business establishments which were judged by three members of the research team to be of potential interest to persons in the through passenger stream and which possessed frontages on either side of U.S. 30 in Nebraska. The 994 business establishments were grouped in the following classes: cafés, motels, miscellaneous lodging accommodations, service stations, garages, drive-ins, commercial recreation and bars, tourist shops, and miscellaneous commercial establishments. Eight hundred and five of these establishments have one principal function and thus can be considered a single unit, but 189 establishments have multiple functions and thus are combinations of two or more units.

[8] A discussion of businesses which service and supply through traffic on a major highway can be found in: Elizabeth Eiselen: "The Tourist Industry of a Modern Highway: U.S. 16 in South Dakota," *Econ. Geog.*, Vol. 21, No. 3, July, 1945.

e.g., a service station and café, or a service station and bar. When each principal function was considered a "unit," the universe of single and combination establishments yielded a universe of 1189 units. Table I presents the total number of units in each of the classes and Table II gives the 189 combinations.

Although the highway business establishments are concentrated in fewer towns and villages on the western half of the highway, than on the eastern half, the distribution of business establishments was, on the whole, remarkably even. There were 504 establishments on the eastern half of U.S. 30 and 490 on the western half. This slight decrease in numbers from east to west is not proportional to the general population decrease. It suggests that the businesses are more closely related to traffic flow than they are to regional populations and it supports the view that the highway complex can be studied as an independent system and culture.

The investigators soon discovered that new businesses were being opened and that old businesses were being closed during the summer months. Thus the census figures are accurate only for a brief period of time. Still the variation was not too consequential since the study was concerned only with the broad characteristics of the small highway business.[9]

The Sample

A stratified 10 per cent random sample, based on the classes of highway businesses listed in Table I, was used. The hope that such a system could be utilized to estimate the error in the quantities estimated for the total universe proved futile, since the samples produced very irregular distributions and some were too small to make generalization possible. However, the stratified sample did allow some comparisons between as well as within the different classes of highway businesses. By comparison with the universe from which the 10 per cent sampling within classes was taken, the sample seemed to present a reasonable model of the highway business complex.

Since the sample was drawn by means of a random number table, no unusual or freakish concentration of business establishments in any single locality was expected. Inspection shows that nothing of this type did occur, and it would therefore seem likely that certain broad inferences about the highway as a whole could be based upon this sample. It is true that no method is available for measuring within reasonable limits the errors of estimation of such inferences, due to the apparent underlying distributions.

It is worth noting that the sample contained business establishments from each of the 13 counties on U.S. 30 and 29 of the cities and incorporated villages. Ninety-eight of the business establishments were located within city limits and 20 outside the limits of incorporated towns and villages.

[9] The general pattern presented by the 1954 census was supported by a 1955 census. In making the latter census, however, the judges used a less restricted definition of a highway business than was used by the judges for the first census. The 1955 unit totals were: service stations 378, cafés 200, motels 170, garages 110, miscellaneous lodging accommodations 87, drive-ins 66, commercial recreation and bars 96, tourist shops 39, and miscellaneous commercial 149. The discrepancies between the 1954 and 1955 totals are in part due to changes on the highway, but for the most part they are the result of the employment of different criteria in judgment. The greatest difference, for example, appeared in the category, "miscellaneous commercial." This particular category of business, however, is least distinctive or characteristic of the highway environment and it is precisely the category which would be most affected by the employment of a less restricted definition of a highway business.

TABLE I

CATEGORIES OF SMALL HIGHWAY BUSINESSES

Category	*Total*	*Total in sample*
Service stations	368	36
Cafés	199	20
Motels	176	18
Garages	121	12
Misc. lodging accommodations	74	7
Drive-in	52	5
Commercial recreation and bars	70	7
Tourist shops	31	3
Misc. commercial	98	10
Totals	1,189	118

The Investigation

During the period August 10 to September 7, 1954, an interviewing program designed to collect basic data on the highway businesses was conducted on the highway. Pre-testing had indicated that the personnel in such establishments had little free time and that the use of a brief interview schedule gave the greatest promise of immediate success. Ordinarily, an interview was of 15 to 20 minutes duration, but some interviews lasted more than an hour. Whenever possible, owners and managers of the business establishments were used as informants, but occasionally it was necessary to interview a well-informed employee. In a few instances the interviewer was received with hostility and in a few, with interest and enthusiasm. Ordinarily, the interviewer met passive cooperation. Most interviews required only a single stop, but occasionally an informant was not available and a second visit was necessary. In the most extreme case, four stops were required before the owner could be interviewed.

One hundred and eighteen interviews were completed. In nine cases it was necessary to use alternate establishments because the business originally drawn in the sample was no longer operating. Alternates were picked for three cafés, one service station, one garage, two drive-ins, and two rooming houses. Including these alternates, interviews were obtained from all businesses in the sample.

The Business Complex

The brief interviews yielded data of general interest. It must be remembered that these findings are based on informants' reports and are thus subject to some distortion and error. It is probable, however, that the general picture is essentially correct.

Table III shows that businesses in the different classes operate in the same location for varying periods of time.

TABLE II

COMBINATIONS OF TWO OR MORE UNITS

Categories	*Number of establishments*
Service station—café	50
Service station—motel	19
Service station—garage	32
Service station—misc. lodging accommodations	2
Service station—drive-in	1
Service station—bar	1
Service station—tourist shop	1
Service station—misc. commercial	2
Service station—café—bar	9
Service station—café—garage	4
Service station—café—misc. lodging accommodations	1
Service station—café—motel	8
Service station—café—misc. commercial	2
Service station—motel—garage	2
Service station—motel—misc. lodging accommodations	2
Service station—misc. commercial—bar	1
Service station—café—motel—bar	1
Café—motel	5
Café—garage	1
Café—misc. lodging accommodations	6
Café—commercial recreation and bar	13
Café—tourist shop	1
Café—misc. commercial	1
Café—motel—bar	1
Café—motel—tourist shop	1
Café—motel—misc. commercial	1
Motel—misc. lodging accommodations	13
Motel—tourist shops	4
Motel—misc. lodging accommodations—tourist shop	1
Motel—misc. lodging accommodations—misc. commercial	1
Drive-in—garage	1
Total	188

Some of them, at least in terms of the era of the automobile, have a respectable age. Still, although turnover varies in the different classes, the over-all turnover is great. For any given management, highway business is short lived. The values of a coefficient of stability (mean length of tenancy of present tenant, divided by mean number of years of business at same location) indicate this lack of general stability. Just as the personnel in the traffic stream is constantly changing, so does the personnel in the maintaining businesses, but the latter change is at a much slower rate.

The coefficient of stability is probably too high in the case of two classes. Two of the five drive-ins used were alternates because the original establishments drawn had gone out of business. Only three tourist shops were represented in the sample and the conclusion of high stability is made on the strength of only three cases.

Characteristically, any single highway business supports comparatively few people. It is also likely to be a family business. Table IV presents data on these points. It is interesting that although no single business was likely to have more than a few employees, a total number of 446 persons were employed by the businesses in the sample. Since this was a 10 per cent sample, it can be inferred that a substantial number of persons earn at least part of their livelihood in establishments on this single highway in Nebraska.

Although the traffic stream varies with the time of day and the season of the year, it is continuous. There are always travelers on the highway. To

TABLE III

STABILITY OF TENANCY OF SMALL HIGHWAY BUSINESS

Category	*Mean no. years at same location*	*Mean length of tenancy in years (present tenant)*	*Coefficient of stability*
Service stations	23	6.75	.29
Cafés	10.75	3.25	.33
Motels	14	6.25	.48
Garages	14	5.75	.41
Misc. lodging accommodations	18	9.25	.51
Drive-ins	2.25	2.25	1.00
Comm. recreation and bars	14	2.75	.19
Tourist shops	15	15	1.00
Misc. commercial establishments	14.5	5.75	.39

TABLE IV

EMPLOYEES OF THE SMALL HIGHWAY BUSINESS

Category	*Total no. employees*	*Men*	*Women*	*Range*		
				Men	*Women*	*Total*
Service stations	101	88	13	0–7	0–1	1–7
Cafés	104	24	80	0–3	1–12	2–14
Motels	48	19	29	0–3	1–7	1–8
Garages	61	58	3	1–12	0–2	1–13
Misc. lodging accommodations	13	2	11	0–1	1–4	1–5
Drive-ins	26	10	16	1–4	0–11	2–12
Comm. recreation and bars	47	22	25	0–10	1–8	2–16
Tourist shops	7	2	5	0–1	1–3	1–4
Misc. commercial establishments	39	15	24	0–4	0–11	1–14
Total	446	240	206	....	....	....

TABLE V

NUMBER OF SMALL HIGHWAY BUSINESSES, WHICH ARE FAMILY-OPERATED

Category	*Total in sample*	*Number, family-operated*
Service stations	36	11
Cafés	20	20
Motels	18	14
Garages	12	1
Misc. lodging accommodations	7	3
Drive-ins	5	2
Comm. recreation and bars	7	4
Tourist shops	3	2
Misc. commercial	10	6

these persons the availability of service establishments is determined not only by geographical location, but also by the hours during which the establishment is open for business. Although each business is likely to have a small labor force, the highway business typically maintains long hours. This is an adjustment to the continuous nature of the traffic stream, and the family character of many of the businesses may make such an adjustment more feasible. Table V shows the number of family operated businesses. Table VI summarizes the data on business hours obtained through the interview.

The foregoing discussion suggests that the characteristics of the highway business complex which are particularly distinctive are aspects of the reciprocal adjustment between persons in the business establishment and persons in the traffic stream. The nature of this adjustment must be examined in somewhat more detail if the highway complex is to be defined.

Business Complex and Traffic Flow

Persons in the business complex who were interviewed were well acquainted with the general nature of the traffic flow and they clearly thought that the trade from the through traffic was important to their businesses. Informants were asked to make judgments on the percentage of their trade which was nonlocal, the percentage of that trade which was due to tourists, the percentage of the persons in the tourist trade who were traveling with children, and the percentage of the tourist trade which was due to return customers. These judgments were made on a five point scale ranging from nearly zero per cent to approximately 100 per cent. The rough estimates presented in Table VII may not coincide with the actual percentages, but they do reflect the perception of informants of the volume, character, and, at least implicitly, the importance of the through traffic trade.

In general, the interaction between persons in the business complex with

TABLE VI

NUMBER OF HOURS THE SMALL HIGHWAY BUSINESS IS OPEN

Category	*Mean number hours open, summer*	*Range*	*Mean number hours open, winter*	*Range*
Service stations	16.75	10–24	16.5	11–24
Cafés	17.75	12–24	16.75	12–24
Motels	22.5	11–24	22.5	11–24
Garages	12.25	8–24	12.25	8–24
Misc. lodging accommodations	24	24	24	24
Drive-ins[1]	12.5	6–17	16.5	16–17
Comm. recreation and bars[2]	15.25	6–24	16.75	12–24
Tourist shops	11.75	10–13	10.75	10–12
Misc. commercial establishments[3]	12	9–17	12	9–17

[1] Three dairy product drive-ins closed in winter.
[2] One, a drive-in theatre, closed in winter.
[3] One, a small grocery store operated in connection with a trailer camp, has no regular hours open for business.

TABLE VII

THE NON-LOCAL TRADE OF THE SMALL HIGHWAY BUSINESS

Category	*Median % of trade, which is non-local*	*Median % non-local trade, are tourists*	*Median % tourists, are with children*	*Median % tourists who are return customers*
Service stations	50	75	75	0 to 25
Cafés	50	75	50	0 to 25
Motels	75	100	50	25
Garages	less than 25	50	50	0 to 25
Misc. lodging accommodations	75	75	25	50
Drive-ins	50	100	75	25
Comm. recreation and bars	25	75	75	25
Tourist shops	75	100	75	25
Misc. commercial establishments	25	100	50	25

their highway customers is defined by the nature of the customary business transactions suggested by the name of each business class. Apparently, the through traveler does not often develop intimate or lasting relationships with the persons in the business complex. While some travelers do become regular customers, even their interaction with persons in the business complex is essentially transitory or fleeting.

It is interesting that while a minority of informants stated that some of their highway customers knew them by name, most said that no non-local customer knew them by name. There is evidence that such recognition on the part of non-local customers is most likely to occur in motels, hotels, rooms, and trailer camps. Most informants stated that they had neither corresponded with non-local customers nor entertained them in their homes. In contrast, some said that they had maintained a desultory correspondence with non-local customers and a few had occasionally entertained travelers in their homes. Again, such interaction is most likely to develop in a motel, hotel, room, or trailer camp situation. Apparently, such contexts offer more opportunity for interpersonal interaction, but even here the relationship is usually that of lodger-manager.

Still informants do interact with customers in ways other than those strictly defined by the business transaction. Every informant had engaged in informal conversations with customers. Thirty-one informants reported having some sort of conversation with nearly all of their customers, and many others estimated that between one-fourth and three-fourths of their customers engaged in conversations with them. Nineteen maintained that they talked little with their customers, but even here there was evidence of such communication. Apparently, this informal face-to-face communication is a concomitant of highway interaction, brief and universalistic as it may be.

The topics of such conversations as reported by informants are of some ethnographic interest. The standard topic of conversation is the weather, but roads and travel conditions are regularly discussed. Other standard topics include the immediate countryside, Nebraska, the local economy (farming, crops, and livestock), and the customer's trip. Other geographical topics are the alfalfa mills, trains, the towns, and tourist attractions. Economic topics include employment and business conditions, prevailing prices, and the lack of money. Some topics relate to the businesses themselves—antiques, photography, eating places,

food, lodging, tourist aids, local entertainment, fishing, and new products. Other highway topics are the highway patrol, traffic and traffic regulations, and the toll bridge. Finally customers sometimes talk about their own homes, lives, and interests. One informant reported exchanging recipes with customers. Only rarely did an informant report talk of possibly controversial topics—one informant did state that the subject of politics was a standard topic of conversations.

There is ample evidence of face-to-face conversation. This talk of neutral and commonplace topics may ease tension and facilitate the completion of transactions between strangers. It relieves the monotony of traveling and work and undoubtedly serves other functions as well. Current highway information of all kinds obtained through such interaction must be a factor in decision making by travelers. Businessmen must learn much about the habits and desires of their customers through such interaction. Some transactions, however, are completed with a minimum of such incidental conversation.

In addition to the occurrence of this face-to-face communication, highway businesses sometimes aid other types of communication by permitting the sporadic use of business telephones by travelers, and by selling postcards or mailing letters. Again the many signs in the highway environment constitute yet another type of communication, which might well be said to provide the major cue system of the modern highway. Every small highway business had on-premise advertising, while only approximately 20 per cent of these businesses failed to use other forms of advertising. Clearly the highway complex is associated with multiple forms of communication.

Other Affiliations of the Business Complex

Two of the motels in the sample are owned by a central organization, and the service stations have various types of association with parent companies. Otherwise the highway businesses are independent establishments lacking central purchasing agencies and the other trappings of large organizations. The highway complex is supplied with goods and services by a wide variety of businesses in local and other communities, but some of these individuals and organizations are so regularly linked with the highway complex that they can be considered a secondary complex supporting the primary complex which in turn supplies the traffic stream. The affiliations of the business complex with this secondary complex can be briefly considered.

The principal distribution centers on the highway are Grand Island and North Platte, but Omaha, Denver, Kansas City, and more remote cities are the homes of organizations supporting the highway complex. In the main, the highway establishments are serviced by organizations based in towns on the highway. In general each business relies on non-local as well as local establishments.

Many of the business establishments deem it worthwhile to be affiliated with various business organizations. Six of the motels in the sample, for example, are included in the 34 motels on U.S. 30 in Nebraska which were listed by the American Automobile Association for 1954. Again, some of the persons associated with highway businesses are active in the Nebraska U.S. 30 Association. More commonly, perhaps, the business supports the local Chamber of Commerce which in turn professes some concern with the highway trade.

Mass media of communication are

TABLE VIII

AFFILIATIONS OF THE SMALL HIGHWAY BUSINESS

Category	*Median percentage who subscribe to trade journals*	*Median % belong to bus. assn.*	*Median no. of suppliers*	*Range of suppliers*
Service stations	16	44	5	1–20
Cafés	40	50	10	3–25
Motels	60	70	4	1–20
Garages	44	56	7	3–50
Misc. lodging accommodations	0	28	0	0– 3
Drive-ins	40	80	6	5–30
Comm. recreation and bars	43	43	20	7–48
Tourist shops	33	67	13	0–50
Misc. commercial establishments	50	60	15	6–30

important in the highway complex, and in some instances these media have a highway focus. Many of the business establishments subscribe to appropriate trade journals. The use of advertising has already been mentioned.

Table VIII provides a summary of the data obtained on these additional affiliations. It must be remembered, however, that the percentages are based only on the reports of informants. No independent investigation was made of the secondary complex.

General Characteristics of the Business Complex

It is clear from the foregoing discussion that small highway businesses are varied in character. In consequence it is difficult to make general statements about the complex as a whole. The following characterization of the total complex must be accepted with some caution.

First, the persons involved in these enterprises and the length of time they remain in a particular operation must be considered. Characteristically, the small highway business is a family business. This is not generally true of service stations, miscellaneous lodgings, and drive-ins, but even in these classes there are many family businesses. A median among categories of 31 per cent of the businesses in the sample are owner operated. The mean number of employees is 3.7. The median length of occupancy of a single location is 12 years, but the median length of tenancy is 5.8 years. With the exception of drive-ins, the businesses are open all year. These businesses are also open all week with the exception of garages and taverns.

Second, informants in the highway complex supplied the following view of their trade: They thought that approximately 50 per cent of their customers were from out-of-state. Of these approximately 80 per cent were thought to be tourists. It was estimated that approximately 50 per cent of these tourists were traveling with children. Less than 25 per cent of the out-of-state customers were considered return customers. All of the businesses used on-premise signs to attract customers, but less than half used other highway advertising. Approximately 20 per cent of the businesses used no other advertising than the on-premise signs. Interaction with customers was usually a business transaction eased by small talk. Close ties were seldom made between informants and customers. It is interesting that the frequency of establishments is more dependent upon the size of the traffic flow than on the size of the local population.

Third, the businesses in the highway complex had relations with still other businesses. Each establishment was said to be supplied by a mean of more than six regular suppliers. Approximately two-thirds of the businesses belong to business associations of one kind or another. Approximately one-third of the businesses had subscriptions to trade journals.

Comment

The small highway business is a part of the highway social system and contributes to its culture. Although the organization of these small businesses is compatible with a rural or small town setting, the interaction between non-local customers and business personnel is urban in character. From the viewpoint of the through traveler, the small highway business complex may be seen as an urban extension. Other facets of the complex suggest, however, that this may be too simple a formulation. Certainly further study of the small highway business is likely to be rewarding both practically and theoretically.

LUNSAR: A STUDY OF AN IRON ORE MINING CENTER IN SIERRA LEONE

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IT is being increasingly realized that many of the so-called "underdeveloped" areas of the world, prominent among which are the intertropical lands, are capable of making, and in some cases are making, significant contributions to the economy and well-being of the world at large. Consequently, they are commanding more and more attention, and widespread interest is being shown in their peculiar problems, one pressing group of which arises from the exploitation of minerals in places hitherto scarcely touched by western patterns of culture. It is the purpose of this article to focus attention upon a mining center of this kind near Lunsar, which lies in the Marampa Chiefdom of Port Loko District about 55 miles in a straight line east northeast of Freetown, the capital and chief port of Sierra Leone. This is part of the area settled chiefly by the Temne tribe.[1] The journey from the capital is rendered tedious and at times dangerous by the bad road surface (which is tarred for only about the first 40 of the 75 miles to be covered) and by the crossing of a ferry (the Rokel ferry) at which the traveller may have to wait an hour or two for a crossing.[2] A private railway, 52 miles in length and owned by the Sierra Leone Development Company, runs to Lunsar from the iron ore shipping port of Pepel, but this is used almost entirely for the transport of ore. From a tiny village of about half a dozen huts in the 1920's the town has increased steadily in population since 1930, until today its population is estimated at about 15,000. It is the reasons for this rapid population increase and the chief results of it which will occupy our attention for the greater part of this paper.

The general geography of this part of West Africa is now fairly well known (Fig. 1). A low mangrove-fringed coast, backed by a swampy belt about 20 miles wide and developed on Pleistocene and Recent sedimentaries (the Bullom Series), forms a kind of feather edge to the main interior region which is built up for the most part on pre-Cambrian crystalline rocks. These are thought to be chiefly granite with schists occurring in certain areas. The granite, which may occupy more than a half of the total area, seems to have been intruded into the schists in later pre-Cambrian times,[3] though since granitization has been observed it is possible that the granites have replaced the earlier schists *in situ*. The schists, which often give

[1] The Temne tribe is one of the two most important tribes of Sierra Leone, the other being the Mende. Exact population figures are lacking, but of an estimated 1,733,618 inhabitants of the Protectorate in 1948 just over 30 per cent were said to be Mende, and just under 30 per cent Temne.

[2] The Rokel is an example of a tidal ferry, low enough down the river to be affected by tides. At the height of the dry season it can only be crossed at high tide.

[3] J. D. Pollett: "The Geology and Mineral Resources of Sierra Leone," Colonial Geology and Mineral Resources, Vol. 2, No. 1, 1951, p. 13.

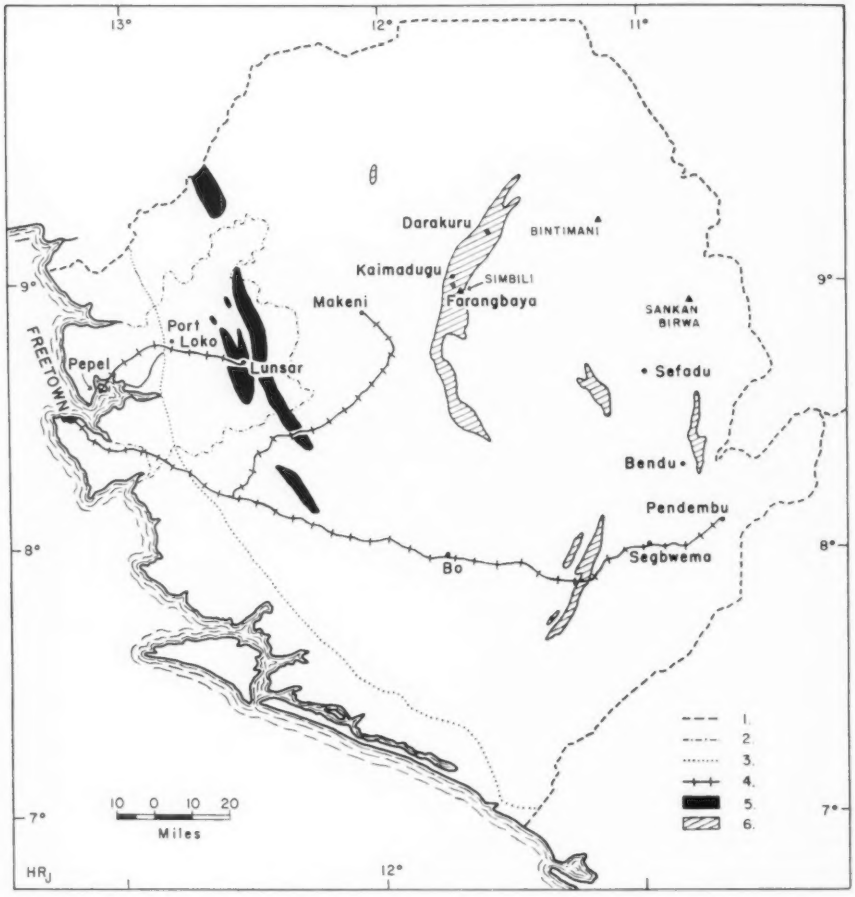

FIG. 1. Sierra Leone (key map). 1. International Boundary; 2. Port Loko District boundary; 3. Western limit of pre-Cambrian crystalline rocks; 4. Railways; 5. Marampa schists; 6. Kambui schists.

rise to hilly country, occur in a number of outcrops, the ones relevant to our study being the Marampa Schists (Fig. 1), the scattered fragments of which may once have been continuous. From the economic point of view the most important constituent of the Marampa Series is a steeply dipping band of hematite-schist which is probably never more than 150 feet thick, but near Lunsar borings reveal that this layer was intensely overfolded in pre-Cambrian times, and this overfolding has produced a total thickness of hematite of at least 1000 feet.

Geomorphologically the interior consists largely of a series of platforms, which often appear to be erosion surfaces, at levels varying from the 35-foot one which adjoins the coastal plain proper to the 5000-foot plateaus of the Tingi Hills and the Loma Mountains and the 6000 foot table-like summits of Sankan Birwa (6080 feet) and Bintimani

(6390 feet). The two latter owe their existence to a capping of coarse dolerite, 250 feet in thickness.[4] It should be observed that the wet tropical climate (Freetown average rainfall, 1941–50, 138.19″; Marampa, 103.52″ over the same period) has resulted in widespread laterization of the surface rocks to a general depth of about 30 feet, though the laterite cover is considerably thicker in some places.

The position of Lunsar is shown on Figures 1 and 2. An undulating plain scored by two fairly large streams and a few tributaries is dominated by Masaboin Hill, which rises up sharply more than 600 feet above the general level, while Ghafal Hill rises nearly 300 feet above the plain to the southwest, a mile or so off the area shown on Figure 2. Both hills are composed of the hematite already mentioned. The "uplands" (the interfluves standing above swamp level) were originally covered with high forest which has now disappeared as a result of the system of rotational farming (bush fallowing, or shifting cultivation) practised in the area, which necessitates the clearing of fresh bush each year for the upland farms. The vegetation consists now, therefore, of a poorly developed secondary bush (low bush), prominent among which stand the oil palms which are not destroyed when fresh farm lands are being prepared. The water courses are fringed with swamps, dry from the middle of December until May, but under water during the rains. The dominant tree in the swamps is the raphia palm, though these palms are widely spaced in the Lunsar area, and they do not occur in the thick stands met with farther south.

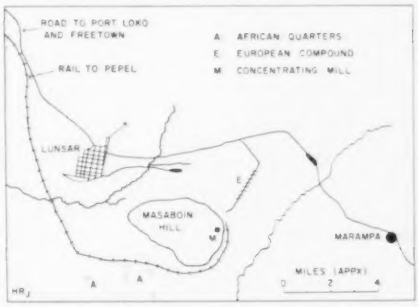

FIG. 2. The Lunsar Area. In the absence of adequate maps this was traced from an official air photograph.

TRADITIONAL FARMING ECONOMY

The traditional farming system practised around Lunsar is similar to that known in other parts of Sierra Leone. The poor upland soils can generally support a crop, usually upland rice, for one year only, after which a period of fallowing which should last for ten years is necessary for soil regeneration.[5] It is customary to interplant another crop such as bulrush millet, guinea corn, beniseed, maize, cassava, beans, tomatoes, or okra with the upland rice, and to plant cassava (always known locally as "cassada") on a field which is being abandoned after cultivation, so that it will grow up along with the bush and afford a reserve food supply especially useful during the hungry season.[6] Rice is the main crop grown in the swamps, and here, too, some fallowing is necessary, the various swamps around a village being cultivated in turn.

The heavy work on the farms, such as "brushing" (clearing away the vegetation) on the uplands, and clearing and digging, is done by the men, who also help with the weeding and the harvest, cut palm fruit, and undertake headloading of cash crops to market.

[4] F. Dixey: "The Physiography of Sierra Leone," *Geogr. Journ.*, Vol. 60, 1922, p. 50.

[5] This figure was given to the writer by an agricultural officer during the course of conversation. It seems to represent a longer period than is necessary in some other parts of West Africa. *The Tropical World;* Pierre Gourou, trans.: E. D. Laborde, London, 1953, p. 88.

[6] The hungry season is not now so serious in Sierra Leone as it was some years ago.

They are also chiefly responsible for house building and repairing. The women perform most of the lighter farm work such as planting crops and weeding, while they help with the harvesting, prepare palm oil, clean rice for sale or for local consumption, and look after the marketing of vegetable crops. Children are responsible for bird-scaring, and they help in all the lighter jobs.

Here, then, is our picture of local farming economy, with its emphasis upon the growing of subsistence crops on the uplands and in the swamps under the bush fallowing system, and with the production of palm fruit as a cash crop.[7] It was into this static agricultural society that an exotic element was thrust in the early 1930's—the exploitation of the iron ore of Masaboin Hill.

THE MINING INDUSTRY

Possibilities of an iron ore mining industry in Sierra Leone were first envisaged in 1926 when Dr. Junner discovered the Marampa ores, and the possibility became a certainty when in 1930 the Sierra Leone Development Company (always known locally as "Delco") obtained the mining rights over these ores and began to develop them. The first step was to arrange for transport and shipment of the ore, and work was at once begun on the railway, 52 miles in length and of 3'6" gauge, to Pepel, where the loading installations were completed in 1933. In this year the first ore was exported. Today trains of 36 bogie wagons regularly make the journey to Pepel, each train carrying 1000 tons of ore concentrate, while at the port 1500 tons can be loaded into a ship per hour. The maximum monthly shipment is 150,000 tons, and is limited rather by the necessity of waiting to get ships away with the tide than by the shore equipment. A ship can be turned, fully loaded, in 18 hours, allowing for all operations. The following figures indicate the annual export of iron ore since mining commenced.

TABLE I

IRON ORE EXPORT

Year	*Tonnage*	*Year*	*Tonnage*
1933	24,550	1944	454,620
1934	229,465	1945	780,350
1935	433,540	1946	603,945
1936	566,595	1947	642,300
1937	633,985	1948	926,370
1938	861,955	1949	974,050
1939	836,861	1950	1,142,621
1940	664,632	1951	1,184,735
1941	1,039,798	1952	1,378,959
1942	631,610	1953	1,200,240
1943	549,755	.....	.....

As an overall estimate, 50 per cent of the total export goes to Britain, while the United States and Germany take about 25 per cent each. Thus, in 1952, of the total export 786,638 tons went to the United Kingdom, 338,090 tons to the German Federal Republic, 237,461 to the United States, and 16,770 to the Netherlands.[8] It is interesting to observe that a recent estimate, probably conservative, puts the iron ore reserves of Lunsar at about 20 million tons.[9]

Masaboin and Ghafal hills are composed of the specular grey hematite-schist which we have already mentioned, and had originally a veneer of red laterite 20–30 feet thick. In fact, therefore, there are two types of ore, the original soft hematite and the hard laterite derived from it, product of the tropical environment. The capping of Masaboin disappeared many years ago, and it is chiefly the soft grey ore which is now being exploited to such effect that the hill now reaches a height of 703 feet

[7] In other parts of Sierra Leone cacao, ginger, piassava, and coffee are produced as cash crops, while the importance of groundnuts is increasing.

[8] *Trade Report, 1952*, Freetown, 1953, p. 89.

[9] J. D. Pollett, *op. cit.*, p. 17.

above sea level (January, 1953) instead of the original 970 feet. The mining operations are simple in the extreme, as the schist can be scraped off the flattish summit, 25 tons being moved behind each of the three caterpillar tractors in use. As the ore is mined it carries about 50 per cent of metallic iron,[10] but after it has passed through the concentrating mill the proportion is increased to about 67 per cent (95 per cent iron oxide, Fe_2O_3), while the phosphorus content is reduced to less than 0.01 per cent. It has been suggested that the waste from the concentrating mill might be a suitable material to use in the production of ceramics, as it is exceedingly fine in texture.

We might notice at this point a difficulty which often confronts industrial undertakings in the tropics—that of obtaining sufficient water for the various processes towards the end of the dry season. Fortunately at Lunsar it has been found possible to recover 80 per cent of the water used during the concentrating process for further use, while 8000 tons are pumped up each day from the nearest river to supply the other 20 per cent and also the various needs (including domestic) of the mines compound. When the river is at its lowest in April and May it is only just possible to obtain this amount.

EFFECTS OF THE INDUSTRY

It is not altogether easy to assess the magnitude of the impact of this industry upon the population of the area, since records of the earlier period are scanty or lacking altogether. For instance, the 1931 Census Report (the last census taken in Sierra Leone was in 1931) gives population figures at district level only, with no further breakdown. All that we can say is that the population for the Port Loko District (Fig. 1) of 12 chiefdoms, of which Marampa is one, is returned as 169,954, giving an average purely on arithmetical grounds of 14,163 persons per chiefdom. This figure is certainly far exceeded in the Marampa Chiefdom today for an authoritative estimate suggests that about 15,000 people are now living in Lunsar alone, and we might observe that this estimate did tally with the results of a quick check count carried out recently by a field group.[11] It further seems likely that 2000 or 2500 people live on the mines compound, and while any estimate of the surrounding local population must be tentative in the extreme we can be fairly confident that at least 18,000 people now live in the Lunsar area. This clearly represents a tremendous increase over the 1931 figure.

It will be abundantly clear that an increase in population of this order must have had far-reaching effects upon the agriculture of this region.[12] Such is now the demand for land that it is no longer possible for an inhabitant to secure land to farm unless he is a native of the area, and preferably a Temne. The bush fallow period of ten years which, as we have already noticed, is highly desirable to permit soil regeneration, is no longer known around Lunsar, where any one plot is now cultivated probably one year in four. The crop of upland rice is grown during the rains, and immediately after the harvest, when

[10] Cf. 30 per cent metallic iron content of English Jurassic ores, and 54 per cent content of the Mesabi ores.

[11] The group consisted of a party of staff and graduate students from Fourah Bay College, Freetown, who spent part of the Christmas vacation, 1952–3, making a survey of the area.

[12] The population of Sierra Leone generally is steadily rising and it is not suggested that the modern more intensive farming which we are about to describe is entirely due to the advent of the mining population. Such farming methods are also appearing in other parts of the country, but the general trend is tremendously accentuated around Lunsar where the population problem is present in its most acute form.

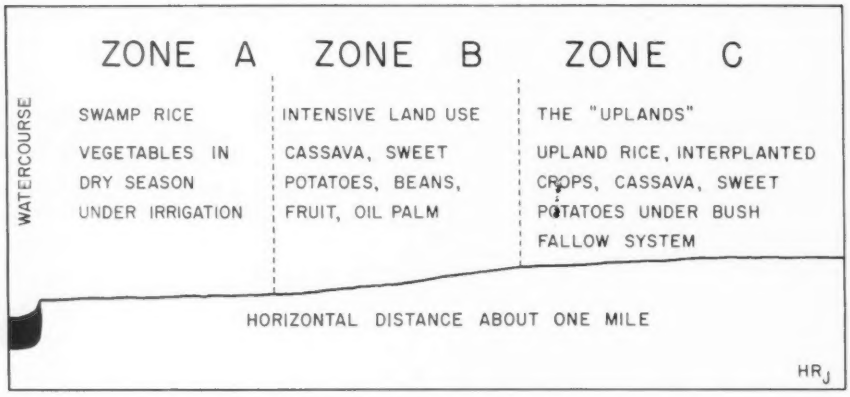

FIG. 3. Land use around Lunsar.

the soil is still moist, cassava and sweet potatoes are planted, the latter as a catch crop before the plot returns to bush. The growing of dry season crops, chiefly vegetables such as cassava, sweet potatoes, and cocoyam, in the swamps under irrigation, is increasing, and this has a twofold effect. Firstly, the vegetables provide much-needed extra supplies of food, and secondly it is found that if the unwanted parts of the vegetable plants—roots, stalks, leaves, etc.—are hoed back into the swamp the fertility of the soil is conserved to such an extent that it becomes possible to grow rice every year. The advantage of this will be clear enough. It is interesting to notice that this planting of vegetables is done first around the edges of the swamps in a narrow zone 6–10 feet broad from which the rice is harvested as early as possible, so that the vegetables can be in the ground before the end of December. On the ground sloping down to the swamps the bush is often cleared to permit the growing of cassava, beans, sweet potatoes, fruit, and the oil palm. Figure 3 represents an attempt to draw together the salient features of land use which we have been describing in schematic form, illustrating as it does an agricultural catenary pattern which constantly recurs around Lunsar.

It is often thought that tropical soils are virtually incapable of improvement, but it is not certain that this is entirely the case. For example, the potentialities of farming in the Lunsar area were clearly seen by the writer after close inspection of a farm owned by a progressive Mende. While the normal rice-cassava-vegetable rotation was carried on in the swamps the area above flood level was intensively used for fruit growing, vegetables (especially beans, sweet potatoes, and cassava) being grown between the well-spaced trees. On this particular farm there were small plantations of oil palms, bananas, and pineapples, while guavas, coffee, breadfruit, coconuts, plums,[13] and citrus fruits (lemons, limes, grapefruit, oranges, and tangerines) were more widely dispersed. Other crops included tomatoes, okra, and tobacco. Careful attention was paid to mulching and composting, and the owner is trying to establish a piggery.

Social tensions are likely to be no less prominent than economic in an area such as this, especially as repre-

[13] The fruit called "plum" in Sierra Leone is quite unlike the plum of temperate latitudes.

sentatives of many different tribes are perforce living in close juxtaposition. Accurate figures of the number of employees are kept at the mines. The following table shows the tribal constitution of the Africans registered for employment on December 29th, 1952.

TABLE II

LABOR BY TRIBES

Tribe	
Temne	1,393
Limba	478
Mende	414
Loko	125
Creole	82
Kono	68
Kissi	60
Koranko	51
Sherbro	44
Mandingo	42
Susu	40
Fulah	36
Total	2,834

In addition, about 60 Europeans are employed in skilled and supervisory capacities, and the relationships between the workers and management appears to be cordial. Care has to be taken, however, to minimize inter-tribal clashes, and on the Delco compound each separate village built by the company for its employees is peopled by members of one tribe only, so that a considerable amount of tribal segregation is achieved. The villages are well planned and have many modern amenities, and the workers are keen to secure homes in them. A fine welfare center, the finest in West Africa, has now been opened by the mining company, with a first-class hospital and recreational facilities.

Conditions are by no means so happy in Lunsar itself, however, where no social services have developed commensurate with the increased population. The town is little more than a mining camp with the usual attendant problems. There is no hospital, only one small primary school, and one Anglican and one Roman Catholic Church. There is a considerable Muslim community, of course, and there is a mosque. The problem of the detribalized native, owing allegiance to no traditional authority, is already present in an acute form.

An interesting and significant social feature is that all activities of secret societies have been officially banned within the town. The reason is easily seen from a single illustration. Suppose the women's society (the "Bundu") arranges a meeting one evening after dark. No person not an initiate will dare to show his face in the street during the hours when the society is in session, and as this group will naturally include all men the result is that unfortunate workers returning from a late shift at the mines will not dare to enter the town and return home until after the session is over! The activities of secret societies clearly can with difficulty (if at all!) be reconciled with the demands of modern industry, and restraint is therefore being put upon them. The long-term effects of this social dichotomy may well be great indeed—and not entirely desirable, leading as it must to further detribalization.

THE NATIONAL SETTING

The emergence of the mining industry clearly presents Sierra Leone with very considerable problems, yet on the other hand it must be remembered that its economic contribution to the country is very great. We must here broaden our view to include the mining industry of the country as a whole, since appropriate figures for the Lunsar undertaking alone are not available, but we might in this context notice that in 1952, the most recent year for which final figures are available, iron ore exports totalled £2,228,685 in value against a total

TABLE III

EXPORTS FROM SIERRA LEONE 1948–1953

Year	*Total exports (value, lbs. sterling)*	*Minerals (per cent)*	*Palm products (per cent)*	*Other exports, chiefly agricultural (percentage)*
1948	4,249,167	41.5	43.8	14.7
1949	5,340,915	41.3	46.8	11.9
1950	6,661,232	44.3	35.8	19.9
1951	10,068,449	29.6*	47.5	22.9
1952	9,924,799	37.7	48.1	14.2
1953	11,738,769	50.1	36.5	13.4

*This drop from the previous level is due, not to a decrease in mineral exports, but to a sudden increase in the values of oil palm products exported. In 1950 the palm exports were valued at £2,283,163; in 1951, at £4,810,021.

mineral export of £3,752,405.[14] Diamonds proved the second most valuable mineral export (£1,217,059), followed by chrome ore (£282,309), and gold (£24,352).

Turning, then, to our national picture, we find that in 1952 mining interests spent no less than £2,106,000 within Sierra Leone,[15] which represents a sum of about £1.2.7d per head of the total population. In that same year 7954 workers were given full and regular employment in the mining industry, and if we concede that each worker has on an average rather more than one person dependent on him (almost certainly a conservative estimate) then roughly one person in every 100 in Sierra Leone gains his livelihood from the mines. This represents a remarkable development of the extractive group of industries, for they have come into being only since 1929 when platinum was first obtained commercially in the Colony. This was followed by gold (1930), diamonds (1932), iron ore (1933), and chromite (1937). There has naturally been a distinct change in the export pattern of the country over this period, for whereas in 1928 palm kernels and palm oil accounted for 78.1 per cent of the total value of exports and kola nuts a further 17.5 per cent, the corresponding figures for 1936 were 38.6 per cent and 1.9 per cent, with mineral exports running at about 57 per cent by value of the total exports. The export pattern for the past six years is shown in Table III.

In conclusion, we might refer to the extensive iron ore deposits near Farangbaya, in the Tonkolili District, situated in the Kambui Schist belt of the Sula-Kangari mountain range, about 80 miles from Lunsar. The deposits have been prospected, and seem to consist of dark blue and red laminated hematite, together with some brown limonite, which dips steeply and strikes in a northeast direction. The main bed of hematite has been traced over a distance of 12 miles, from Simbili Mountain (2440′) nearly to Darakuru, though it is intermittent, occurring in the mountains only. It has been, so to speak, sawn into blocks by the mountain streams. Analyses indicate that the ore averages more than 60 per cent of iron, and it is estimated that well over 100 million tons of ore may be available. There are proposals to open up this rich field by extending the railway from Lunsar to Kaimadugu near Farangbaya, but the future program of development is

[14] *Trade Report, 1952.* Freetown, 1953, p. 96. Provisional figures for 1953 suggest an even greater predominance.

[15] £1,067,000 in taxation, £685,000 on salaries and wages, and £354,000 on services, local purchases, etc. *Annual Report of the Mines Department, 1952.* Freetown, 1954, p. 1.

as yet by no means definite. An unexpected difficulty, typical of the unforeseeable situations which might arise in newly developing areas, has arisen over the question of surface and subsurface rights. The Central Government owns all minerals under the surface, and has, therefore, come to an agreement with Delco with regard to the mining of the Tonkolili deposits, but local interests are not in agreement with all the terms arranged. The resulting situation is somewhat of an *impassé*, because the local Native Authorities control surface activities, and it is of little avail for Delco to have authority to mine these ores if it has no surface access to them! Even yet, therefore, the future program is by no means clear.

What is clear is the fact that Sierra Leone possesses large reserves of mineral deposits, the extent of which is not yet fully known (even within the last few months a large new chromite field has been plotted at Bendu near the French border, east of the Segbwema-Sefadu road). The signs are that the mineral output of this Colony and Protectorate may well increase substantially, even in the immediate future, and this can only result in a further strengthening of the economic foundations of a country for which the future seems indeed bright.

THE PATTERN OF SEX RATIOS IN NEW ZEALAND

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ACKNOWLEDGE of how population is distributed amongst the various age groupings and between the sexes is fundamental to the understanding of that population and the community that it forms. Residence, age, and sex ratios constitute the three primary lines of research in any demographic study; a knowledge of them helps to explain employment and consumption patterns, social needs, and, perhaps, the psychological characteristics of a community. In a recent paper Trewartha stressed the fact that age groupings and sex ratios are also fundamental to the geographic analysis of an area, for they are important features of the landscape, "invisible" though they may be, and as such provide additional means and materials for analyzing regional landscapes.[1]

Field observations made by the present writer suggested that there might be differences between the sex ratios of the sheep areas and those of dairy areas within New Zealand, apart from the broader rural-urban differences. Such is the case. The writer's purpose is to describe the regional variations of the sex ratio and to attempt some explanation of the pattern which occurs. This latter intention contained the most difficulties, and complete explanations are not offered. The investigation revealed some new problems many of which seem basic to the understanding of New Zealand's geography but which require further field studies for their solution. Though description and analysis are the prime aims of the paper, such is the nature of the material used, and so rarely do geographers use such material, that it is necessary to include a discussion of methods and the nature of the statistics upon which the description is based.

[1] G. T. Trewartha: "A Case for Population Geography," *Annals Assn. of Amer. Geogrs.*, Vol. 43, 1953, pp. 71–97.

Aspects of Sex Ratio

It is common practice to express the sex composition of a population as a ratio. The ratio used by the New Zealand Census is expressed as number of females per 100 males, so that a figure of less than 100 means there is a relative absence of females in a particular area, and a figure greater than 100, the converse. This method of expressing the ratio is not universal; some countries, e.g., the United States, express the ratio as number of males per 100 females. It is easy to convert a ratio expressed in one fashion to a ratio expressed in the alternative manner. The New Zealand ratio, number of females per 100 males, is the one used throughout this paper.

A common demographic feature of countries settled by West European peoples, or strongly influenced by West European culture and its derivatives, is that, regardless of the overall distribution amongst the sexes, rural areas display a high degree of masculinity,

i.e., there is a relative absence of females, and urban areas have a high degree of femininity. In 1940 the native white population of the United States had almost a balance between the sexes, a ratio of females to males of 99.9; but the rural farm ratio was 87.8, and the urban ratio, 105.5. At the time of the 1951 census for New Zealand the ratios were: total population 99.1; rural 88.5; urban 107. From those figures alone it will be appreciated that the ratio is a significant demographic and cultural index and can be of value in a discussion of regional characteristics. Furthermore, the ratio can reflect a stage in the historical development of a population.

It is necessary to remember that the sex ratio states a simple relationship between the numbers of females and males of a population. The numbers themselves are a result of a series of factors: mortality rates, wars, migrations, and stages of economic development. The ratio is a sum of these factors and in a limited sense reflects them, especially when the sex ratios of different age groups are studied. In countries such as Great Britain, the United States, and New Zealand the female rate of mortality remains lower than the male after the early years, and, although in all countries more males are born than females (in New Zealand the sex ratio at under 1 year is 96.5), the effect of these differing mortality rates is to wipe out the initial masculinity of the population. In the later years there are consequently more females than males, so the ratio for the total population is above that for the under-one-year group.

Several generalizations are possible. War casualties, for example, disrupt sex ratios. Since this loss of life is chiefly among men, the tendency should be for the ratio to increase in wartime. In populations which have been undisturbed by migration the longer life expectancy of the females results in an overall excess of females; e.g., note the following prewar ratios: Denmark 103, Norway 105, Sweden 102, United Kingdom 105. In countries which have experienced considerable immigration the ratio is low despite the longevity of the female population, because this factor is counteracted by the excessive number of males common among migrant populations. Note the following prewar ratios: Canada 95, Australia 97, Argentine 85, and New Zealand 97. With time and economic development such populations tend to become more balanced in their sex composition, the ratio approaching or exceeding 100. This is illustrated for New Zealand by Table I. Thus the sex ratio should be used in conjunction with a knowledge of the socio-economic factors and the historical events which have influenced the development of a population.

TABLE I

SEX RATIOS FOR NEW ZEALAND SINCE 1881

1881	81.7	1926	95.7
1901	90.3	1936	97.0
1911	89.6	1951	99.1
1921	95.6		

EUROPEAN-MAORI CONTRASTS

One of the best ways of demonstrating how the ratio reflects socio-economic conditions is to contrast the ratios for two differing cultural groups, the European and Maori communities of New Zealand (Table II).[2] The relationship between residence and the ratio is displayed in both communities, but it is

[2] Sex ratios and numbers contained within the various age groupings have been computed by the writer from figures published in Vol. I, "Increase and Location of Population," and Vol. II, "Ages and Marital Status," of the *1951 Population Census*, Government Printer, Wellington, 1953.

TABLE II

CONTRASTS IN SEX RATIOS, NEW ZEALAND, 1951

European community		*Maori community*	
Total	99.5	Total	95.1
Urban	104.3	Urban	111.2
Rural	88.0	Rural	91.5

important to notice that the Maori rural ratio does not diverge so greatly from the Maori total ratio as does the European rural ratio from the total European ratio. In effect the Maori population shows a somewhat better balance between the sexes in rural areas than the European. The Maori is more rural than the European (Maori, 81 per cent rural; European, 36 per cent rural) and the factors influencing the residence of European women in country districts do not have the same force among Maori women; e.g., the Maoris tend to live in closely-knit communities rather than the isolated homestead common among Europeans. That the Maori urban ratio is higher than the European may result from the pattern of Maori employment. Relative to the white male, the Maori does not find employment in secondary and tertiary industries of the towns but in the rougher laboring jobs, such as scrub cutting, fencing, construction, and road work, which are largely rural. Most Maori female employment in contrast is to be found in the towns.

Why the total Maori ratio should be lower than the European is difficult to explain, but it cannot be influenced by immigration. Because the Maori population is a very young one, much younger than the European, it is possible that the predominance of males at birth is affecting the ratio. Whether or not the ratio also reflects the fact that Maori females may possibly be receiving less care during early life, or during the reproductive periods, cannot be definitely stated. However, "The mortality rates for the two sexes are much more nearly equal for the Maoris than for the rest of the population, the female rate being indeed higher than for the male in some years."[3] One consequence of these differing socio-economic conditions influencing the ratio is that when studying the ratio from a regional point of view it is necessary to separate the two communities; but since the Maori is of little consequence in the population of the South Island the separation is necessary only for the North Island.

REGIONAL SEX RATIO PATTERNS

When mapped, the ratios reveal a distinct pattern significant to the geographer (Figs. 1–4). Unfortunately, the divisions offered by county boundaries are not as fine as might be desired, and little can be done to overcome this hindrance. In describing the regional patterns of the ratio it seems most suitable to discuss separately the rural ratios for the North Island, the rural ratios for the South Island, and the urban ratios. However, a few general remarks may be made. There is a considerable variation between the rural ratios for individual counties. Though the rural ratio for the whole Dominion is 88.5, it can fall to 63.6, as in Waimarino County, and rise to 101.9, as in Peninsula County adjacent to Dunedin City. Generally, the high and inaccessible county has a low rural ratio and counties nearer to the larger urban centers have high ratios. From another viewpoint, the more intensively farmed areas have high ratios; the less intensively farmed areas have low ratios. As a whole, urban ratios are higher than the rural ones, though there is a

[3] *New Zealand Year Book*, 1953, p. 87.

range among urban ratios, but no apparent relationship exists between the size of an urban settlement and its ratio.

NORTH ISLAND RURAL

Most clear-cut in its regional patterns is the map of European rural ratios (Figs. 2 and 4). In the North Island, ratios are average or above average (i.e., the national rural average) in the lowland dairying and sheep fattening areas such as Northland, Waikato-Hauraki, Western Taranaki, Manawatu, and Hawkes Bay. However, a high ratio is not only associated with the farming characteristic of these areas but with the proximity of large towns and cities. Among the counties with ratios more than 5 above the rural average it is noticeable that practically all are near such centers as Wellington, Palmerston North, Wanganui, New Plymouth, Hawera, Auckland, and also Napier-Hastings. Though none of the Waikato towns have near-by counties with ratios much above the average, most of the ratios are slightly above the average, as is the ratio for Cook County which is adjacent to Gisborne. The influence which urban centers exert on rural ratios is explained later.

Three rural districts of the North Island—the Western Uplands, Central Plateau, and large stretches of the East Coast (East Cape–Cape Palliser)—record high degrees of masculinity, having ratios more than 5 below the rural average. All three are characterized by their relative inaccessibility and the prevalence of store sheep and cattle raising, though dairying is of growing importance on the Central Plateau; but they may be differentiated by their stage of economic development. During the period 1921–51 the number of livestock units for the whole of the North

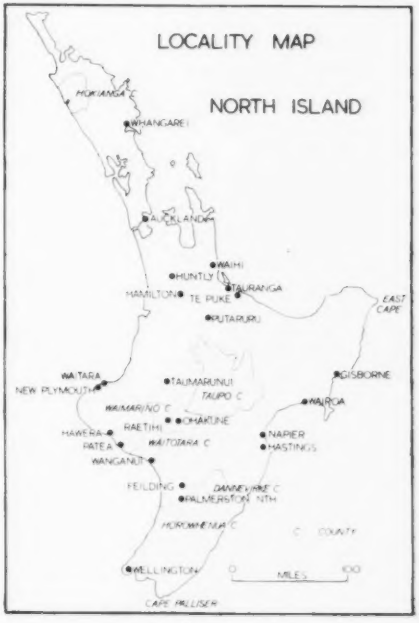

FIG. 1.

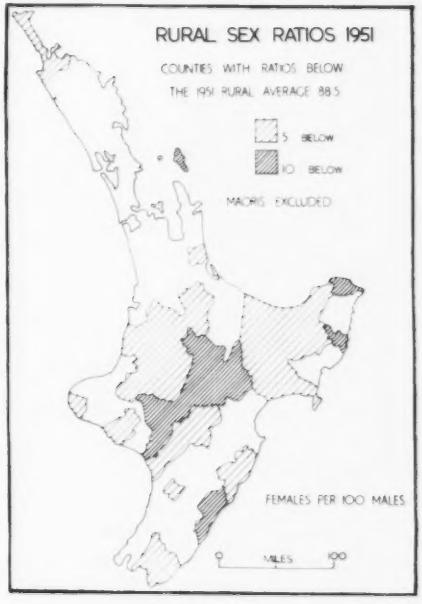

FIG. 2.

TABLE III

PERCENTAGE INCREASE IN NUMBER OF LIVESTOCK UNITS BY SELECTED REGIONS, 1921–51

	Central plateau	*Western upland*	*East coast*
Constituent agricultural regions....	Central Plateau 307.8	Western Uplands.....83.4 Rangitiki.....45.0	Castlepoint.....5.7 East Cape.....22.7 Featherston.....19.7

Island increased by 79.7 per cent.[4] The increases in stock units recorded during the same period by the agricultural regions, which are practically of the same extent as the above areas, are shown in Table III.

The low sex ratios recorded by the Central Plateau are associated with a rapidly developing economy, pioneer areas customarily showing high masculinity. In contrast, the low ratios of the East Coast are a result of the type of farming and the social consequences of inaccessibility. The high masculinity of the Western Uplands derives from its pioneer aspect, its farming, and its inaccessibility. Not only is dairy farming developing in the Central Plateau area, but the exploitation of timber and hydroelectric resources is under way. In 1951 populations recorded for nucleated settlements were as follows: associated with forest development, Tokoroa 1193, Edgecombe 812, Te Teko 558; with hydroelectric schemes, Mangakino 3815. All these populations were classed as rural and were of course predominantly male.

The East Coast ranks as the main area of hill sheep farming in the North Island and contains some of its longest-settled districts. Economically, it is not a rapidly developing area and although the region has some potentialities for development they are not of the order of those of the Central Plateau. Furthermore, farming is faced with a number of serious problems, among them soil erosion and overgrazing, accessibility, and uneconomic size of holdings. The Western Uplands is difficult country to farm, being a region of steeply dissected soft sedimentary rocks and having a high rainfall which aids the rapid regeneration of native plants on pastures under exotic grasses. Holdings are large and isolated; roads are poorly developed and maintenance costly. The settlers at the beginning of this century suffered some severe setbacks, and the region has never lost its pioneer aspect.

The Maori population of the North Island is not evenly distributed across the countryside, and consequently no attention has been paid to those counties in which the Maori population constitutes less than 10 per cent of the population. Even then, in some cases, the size of the Maori population in a particular county is so small that the ratio can be influenced by the smallness of the numbers involved rather than any socio-economic factors. However, it may be noticed that ratios more than 5 below the Maori rural average are recorded for parts of the Western Uplands and Taupo County, which is in the Central Plateau area.

More significant are the above-average ratios recorded in some areas or counties where fairly dense settlements of Maoris exist. The East Cape and Bay of Plenty have ratios more than 5 above average, as do Wanganui, Horowhenua, Dannevirke, and Hoki-

[4] Figures taken from J. V. White: "Livestock Farming in the North Island. A Study in Production Trends and Potentialities," *Dept. of Agric., Wellington*, 1954.

anga Counties. These ratios, it is felt, reflect the fact that Maori communities in rural areas are affected differently by the cultural factors that influence the Europeans. It is suggested that the rural Maori, living in closely-knit communities in more nucleated settlements than the whites, is not influenced so much by the problems of rural isolation. Moreover, the Maori has a stronger psychological attachment to the land, and the pressure is not as great as it is among the whites for the adolescent and widowed females to move toward the towns either for employment or retirement.

SOUTH ISLAND RURAL

Many features associated with the rural ratios of the North Island occur again in the South Island. Those counties adjacent to urban centers or with more intensive types of farming tend to have higher than average ratios; whereas the more inaccessible and less intensively farmed areas have lower than average ratios. The following areas display ratios equal to, or above, the rural average: the counties of Takaka and Waimea, where there is intensive fruit and tobacco growing; and the boroughs of Nelson, Richmond, and Motueka. Marlborough County also contains the intensively-farmed area adjacent to Blenheim, and the area about the borough of Picton. Ratios are generally high in the counties about Christchurch and Dunedin; and they are average or slightly above average in the mixed farming areas of the Canterbury Plains and the dairy-sheep fattening areas of Southland. On the basis of their relative inaccessibility, Vincent and Maniototo Counties were expected to have low ratios; this is not the case, they are about 2 below average. Mackenzie and Tuapeka Counties do record the expected low ratios, but the ratios are markedly influenced by a large number of males temporarily living in hydroelectric construction camps. Of a total population of 4033 in Mackenzie County, 1138 were in hydro works; for Tuapeka, total population 5941, in camps 1372. It would seem that the ratios for Vincent and Maniototo are the normal ratios for those parts of Otago, and that

FIG. 3.

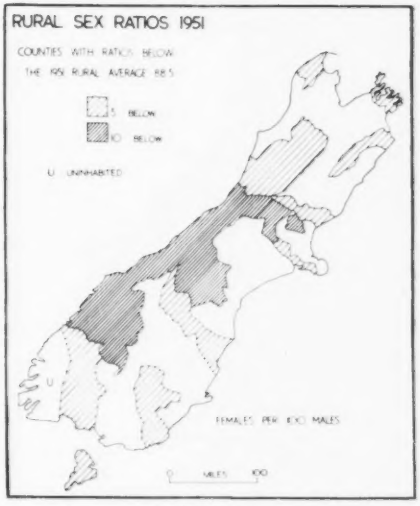

FIG. 4.

the other two are exceptional. This suggests that the close relationship of inaccessibility and ratios does not hold in these cases.

The isolation of the West Coast of the South Island is one of its outstanding geographic characteristics and a low ratio is associated with this isolation. It is rather surprising to find the ratio of Buller County, 84.5, is not as low as that of other West Coast counties. The explanation is to be found in the character of mining settlements. Though the ratios of mining towns are lower than the average New Zealand urban ratio, they are nevertheless a little above the rural average. About a fifth of Buller's rural population is in fact urban rather than rural, living in small mining communities, and the effect of including these communities in the rural population is to raise the ratio somewhat. In addition to the West Coast, the isolated counties of Stewart Island, Wallace, Lake, Collingwood, Sounds, and Awatere all show high degrees of masculinity.

URBAN RATIOS

Urban areas have characteristically more females than males. When variations in urban ratios are inspected, a number of points stand out, especially concerning those settlements whose ratio falls 5 or more below the New Zealand urban average ratio. Because so many of the examples accord with similar conditions elsewhere in the world they may be taken as significant. Towns associated with coal mining districts have ratios below the average; this is true of Westport, Greymouth, Brunner, Runanga, Kaitangata, and Huntly. Waihi, a former gold mining town, still shows the effect of its past history with its high masculinity. Most of the towns associated with freezing works have low ratios; e.g., Waitara, Patea, Feilding, Wairoa; and, in the South Island, Kaiapoi, Balclutha, and Mataura. It also seems a fair presumption that, in part at least, the low ratio of Kairanga County is to be explained by the presence of the Longburn Freezing Works. Industrial areas of the large urban centers also tend to show low ratios: Petone near Wellington, and Green Island and Mosgiel near Dunedin. Finally, some of the towns associated with development schemes, like Putaruru, Te Puke, and Roxburgh (Tuapeka County), and urban centers serving the more isolated parts of the Dominion, Taumarunui, Oakune, and Raetihi, also record low ratios. In all cases the ratio is affected by the type of industry and employment offered.

ANALYSIS OF REGIONAL VARIATIONS

When mapped, these ratios provide a useful tool for the regional analysis of New Zealand. They point not only to the major distinction between the rural and urban areas, but to the distinctions between the more intensively and less intensively farmed areas, the pioneer districts, and in some cases between the various urban areas. Generally speaking, the regional map which might be drawn from the distribution of these ratios would be very much like a map of the more conventional regional divisions. In effect, the ratio is an index of socio-economic conditions prevailing in these regions, and if carefully analyzed and interpreted the ratio can be used both to widen the knowledge of those social and demographic conditions, and to integrate the socio-economic facets of regional life. A preliminary analysis is now attempted.

A valuable approach is to consider the ratio in relation to age and residence, for the ratios used so far are no more than the mean of a number of ratios for each age group. Any sub-

stantial analysis depends on the accuracy with which ages, especially female ages, are stated on census returns. American experience is that females consistently understate their ages, the 15–25 age group being especially popular.[5] The writer raised this question of misstatement with the officers of the Bureau of Census and Statistics only to learn that in their opinion there is no misstatement of female ages in New Zealand which is of any consequence. This is not the place to discuss the evidence, which appears to the writer as satisfactory. In this respect a discussion of ratios by age groups is not invalidated.

TABLE IV

SEX RATIOS BY AGE GROUP AND RESIDENCE (INCLUDING MAORIS)

	All N. Z.	*N. Z. cities and boroughs*	*N. Z. rural*
0–5	96.0	94.2	95.3
5–15	96.5	99.0	93.2
15–25	95.6	109.0	80.0
25–35	100.0	106.7	92.8
35–45	98.0	105.2	87.0
45–55	97.0	106.0	82.8
55–65	107.4	118.7	87.4
65 and over	109.4	123.7	82.6

It is apparent from inspecting the New Zealand figures (Table IV) that the ratios of the 0–5 and 5–15 age groups are affected by the biological fact that more males than females are born. With time the numerical advantage of the males lessens. In 1951 there were 799 more males than females at 0 years; at 15 years, 633 more males, at 20 years 297 more males; but at 25 years the figure was 705. The increase may be explained by immigration.

From the latter half of the 15–25 age group to the 45–55 age group the ratio is influenced by the interwar and postwar immigration to the Dominion. Thus a person aged 50 in 1951 would have been 20 years old in 1921, so that the "fifties" represent the first batches of interwar migrants. The migrants have, naturally, included more males than females; this tends to lower the ratios for these age groups. It will be noticed, however, that the 25–35 ratio, despite immigration, is 100. The casualties suffered during the Second World War explain this feature. The ratios for each year of age show that the female ratio rises above 100 at 30 years (i.e., the group which was 19 years old in 1940) and falls below 100 at 37 years (i.e., the 26 year-olds in 1940). The ratios of the 55–65, and 65-and-over groups are influenced by the higher mortality rates of the males and the greater life expectancy of the females. At 53 years of age the female numbers exceed the male numbers for the first time (with the exception of the age groups influenced by the war), and remain above the male numbers from that age onwards. War, migration, and the socio-economic factors affecting the longevity of females all help in determining the ratios for the whole country.

INFLUENCE OF FEMALE MIGRATION

The urban and rural ratios show markedly differing trends, and the principal explanation of these trends is to be found in the migration of females from the rural districts to the towns. Naturally, there is little difference between the rural and urban ratios in the 0–5 age groups, and not much difference in the 5–15 age groups. One suspects that what difference there is may arise through more rural girls than boys going to boarding schools, which are mainly in urban centers. During the early years of employment the variation between rural and urban ratios becomes very marked; the change is to be explained largely by the movement of

[5] T. Lynn Smith: *Population Analysis*, McGraw-Hill Book Company, New York, 1948, pp. 116–122.

females from the country to the towns, partly for reasons of employment and partly for social reasons. And it would seem that comparatively few of the females who migrate to the towns ever permanently return to the countryside. Of course there is some movement of males to and from the country, and some females also may leave the towns for rural districts. Especially in pioneer areas the influx of males is likely to depress the ratio. But the only general explanation of the change in the ratio is either a large migration of males to rural areas, or a migration of females to the towns.

The pattern of female employment and the most prevalent ages at which females are employed supports the argument for the importance of female migration. In 1951, of the total occupied females, 41½ per cent were in government and administration, education, health, and personal service; 22½ per cent were in commerce, wholesale and retail trade, banking, and insurance; 24 per cent were in manufacturing. The majority of these industries are located in towns. Furthermore, in 1945, 46½ per cent of the total occupied female labor force was between the ages 16 and 25; and 69 per cent of it was between 16 and 35.

The rural ratio for five-year age intervals shows a marked drop for the 15–20 group and then a recovery up to the 30–35 group. These variations suggest a number of points. The drop from 92.5, 10–15 age group, to 76, 15–20 age group, results from the migration to the cities. The recovery of the ratio in the following three age groups occurs because some of the females return to the country, largely to get married. That the rise in the 25–30 rural ratio coincides with a decline in the urban ratio for that age group lends weight to the argument. So do two other facts. Whereas the percentage of rural females in 15–25 age group is below the New Zealand figure, the percentage for the 25–35 rural age group rises above it. What is more, since only 9½ per cent of the females in the 25–35 rural age group are unmarried in the North Island rural areas it would appear that most females who are to return to the country for the purpose of marrying will do so before the age of 35. However, it must be admitted that the casualties of the Second World War will also affect the ratios, especially that of the 30–35 age group.

After the 30–35 age both the rural and urban sex ratios tend to decline, and one presumes the reason is to be found in immigration. The rise in ratios at 55–60 reflects once more the losses of war, this time the 1914–18 war. At about 65 years a most interesting divergence in the two ratios takes place. Like the New Zealand ratios, the urban ratios rise, displaying partly the effects of the lower female mortality rates; but the rural ratios remain the same. This can be explained largely by the migration of the older females to the urban areas and the older men remaining in the countryside.

The study of the ratios by age and residence demonstrates that to a large degree the masculinity of rural areas occurs because of the transfer of females to urban areas, especially during the early years of employment and the years of retirement. Some of the females who first leave for work in the town do apparently return to the countryside, but the majority never do return. An influx of males, especially in the pioneer areas, will also lower the rural ratios and this must be taken into account; but an inspection of county ratios by age, in areas other than pioneer districts, supports the argument that the low ratios are largely attribu-

table to female migration which is in excess of any male migration.

SOCIAL AND ECONOMIC INFLUENCES

The relative absence of females in the rural areas of New Zealand may be explained by certain social and economic features of life in the Dominion. The influence of female employment in the urban areas has already been discussed. Together with the social attractions of city life, opportunities of employment constitute the "pull" to urban areas. The factors constituting the "push" from rural areas demand further analysis. Inaccessibility and lack of the amenities of rural life are important.

It will have been noticed that a low ratio and inaccessibility go together. The relationship of the two requires careful appraisement, for accessibility is a relative term varying with time and place, and varying in significance for different social groups. Accessibility varies with the stage of economic development, and as New Zealand's economy and wealth have expanded so have roads improved and the number of cars used increased. It is surprising to learn how much of New Zealand is within 30 miles, i.e., two hours driving for the return journey, of towns of 3000 and over. In towns of this size the range of services offered is considerable. Psychologically the New Zealander is rather contemptuous of distance, and the facility with which he undertakes long journeys and the speed he maintains during these journeys is astonishing to a person from the Old World. Nevertheless, even allowing a 30-mile distance between home and town means probably no more than a weekly shopping and cinema visit.

There are large areas, among them the Western Uplands, Central Plateau, East Cape, parts of Northland, and the South Island, which are definitely inaccessible whatever basis is chosen for measurement. Furthermore, the accessibility of rural areas as a whole is a fairly recent state. The automobile has been the prime means of improving accessibility, but it has been of significance only since the 1920's. The low income of the depression period plus the wartime restrictions on travel reduced in some ways the car's significance, so that it is only since the war that its full effect can have come into operation. This means there are a considerable number of rural people, say in the 35-and-over age groups, who have been influenced by these earlier conditions when accessibility was not so good.

SHEEP FARMING COMMUNITY

The raising of store sheep is the predominant activity of the more isolated areas of New Zealand, and a number of factors are against the development of a rounded social life in sheep country. Homesteads are considerable distances apart, and daily contact with neighbors is restricted, though the party telephone line is used to overcome this disadvantage. One-teacher schools are common, in which all ages from 5–15 are taught, often in the same room. Generally, secondary education can be obtained only in the towns. Though there is much to keep the wife busy around the house, there is comparatively little but mundane tasks to interest the daughters; and they have few chances of meeting other young people. The local area may possess a vigorous football team and there are occasional parties and dances, but the range of tastes catered for is limited, and the activities unvaried.

The social grouping in store-sheep farming districts is of rather distinctive pattern. Generally, the owner and his

family maintain a high standard of living. Their children often go to respectable boarding schools, and such families are considered to be among the social elite of the Dominion. For such groups accessibility is not much of a problem. They are wealthy enough to maintain one or two cars, and the nature of sheep farming is such that the owner and his family may be absent from the farm for frequent or long periods. What disadvantages there are associated with rural life are markedly curtailed for this group. On a sheep station the only other family group will be probably that of the manager or head shepherd. Economically his family is secure and reasonably well housed, but the chief shepherd is more tied to his job than the owner, and his family is relatively more isolated. The relationship between this group and the owner group varies with the individual outlook of the owner, but generally it is formal and limited. Company for the wife has to be sought amongst her own kind, who are dispersed on isolated stations. The third group represented on the station is composed of the shepherds and laborers and rabbiters plus the seasonal itinerant scrub cutters and shearers. These largely constitute the unmarried male sections of rural areas. Their dwellings are rough and primitive, unattractive as a future home to any intending bride. Economically they are in the least secure of positions, especially in times of depression. Of all groups they are the most isolated, inaccessible, and poorly supplied with amenities. This was especially true in pre-war days, though post-war prosperity has improved their conditions.

This pattern is a generalized one. There are variations; the owner himself may be a bachelor, there may be other families on the station in addition to the head shepherd's. But the third group is always represented and largely constitutes the group of rural bachelors which the females of the area have, in a sense, rejected in preference to the men or life of the towns, mainly because of the disadvantages of rural life.

The low ratios of the pioneer areas have been attributed to the influx of males in addition to the usual factors affecting females. The low ratios of the sheep areas have been explained in terms of employment, isolation, and inaccessibility and other social disadvantages of life in those areas. The high ratios of the towns arise out of these and other factors. The differences in ratios between the more intensively and less intensively farmed areas finally needs explanation. The sex ratios are influenced by types of farming and their labor needs, patterns of settlement, and the statistical definition of rural.

DAIRY FARMING COMMUNITY

The lowland areas of the Dominion are given over to the more intensive forms of agriculture, principally dairying and sheep fattening, with some vegetable and fruit growing. Both fattening and dairying differ from high-country farming in that holdings are smaller and the labor requirements different. Both types are largely family farms so there is not associated with them the number of single men who act as laborers on the hill stations. The social disadvantages facing women in these areas are considerably less than in the remote parts. Density of settlement is greater, roads better, and people much less isolated.

Urban centers of over 1000 are never far apart, generally less than 16 miles, and in addition there are a large number of small settlements, or villages, around which centers a vigorous social life car-

ried on in guilds, clubs, and church organizations. Weekly dances and film showings are common. The urban centers are linked to the farms by bus services which, if not frequent, are, nevertheless, adequate for shopping and workers' needs. It is possible for the younger members of farming families to travel daily to work, and adolescent females, especially, can find satisfying employment without leaving the family. From the aspects of social life and employment these areas have greater advantages than the remote areas, and consequently the "push" from the rural districts is probably not as great.

VILLAGE AND SUBURBAN COMMUNITIES

The nature of these villages is of some significance in the discussion of the ratio. Apart from their social importance in rural life their effect is to diversify the occupational structure of the intensively farmed areas. Though the populations of these settlements are classed as rural, the functions of the villages are primarily urban. It is uncommon to find any of the farming community living within the village. The inhabitants are concerned with distribution and collection, and the supply of social and economic services to the farming community. The villages offer a limited but important range of openings in employment: in the butter and cheese factory, the garage, the few retail shops, the post office and telephone exchange, agricultural contracting, and, more recently, in some areas, in the branch factory of a textile firm. In addition, the villages house the county road workers and railway employees, and also serve as places of retirement.

In these respects the villages are more urban than rural; one might use in their case the term rural non-farm, though it has disadvantages. Whatever they are called they possess certain aspects—form, occupational structure, and some functions—which are distinctly urban. It follows, especially from their occupational structure, that their sex ratios tend to be higher than the rural farm ratios. This aspect of their demography can be demonstrated by reference to the Independent and Dependent Town Districts. These are nucleated settlements which for historical reasons are separated for statistical and some administrative purposes. They fall into two groups: those larger than 1000, generally suburbs of cities, like the Wellington suburbs of Tawa Flat and Johnsonville; and those less than 1000, like Kaponga (near Hawera), which possess the characteristics of the villages described above.

The "Tawa Flat" type of settlement is really a small borough and the average ratio for this group is 105. The average ratio for the second or "Kaponga" type is 97.5. The average ratio for all Town Districts is 100.8. For individual settlements of the Kaponga type ratios do vary, one falls as low as 70.5, but most are around the mean. If the populations of the individual Town Districts of the Kaponga type are added to their respective county populations and a new ratio computed, the effect of the addition is generally to raise the county ratio by about 2. Such computations are not unreasonable, for many counties contain villages which are as large as the Kaponga-type settlements. Because the villages do not possess the status of town districts their population is classified as rural; yet demographically they are different from the farming community. The result of their inclusion is in effect to raise the county ratio. The more intensively farmed areas contain most of the Dominion's villages, and so the prevalence of villages may be regarded

as a factor influencing the higher ratios of the sheep fattening and dairying areas.

The New Zealand Census implicitly defines rural population as that outside the boundaries of cities, boroughs, and dependent and independent town districts. When the composition of this rural population is inspected it becomes apparent that such a definition permits the inclusion of a number of diverse items. Included within the total rural population of the North Island are some 66,000 persons living in nucleated settlements of more than 300 persons; 14,000 persons living in nucleated settlements of less than 300 persons; 3000 military personnel; and 6000 persons in schools, prisons, hospitals, and mental institutions.

The influence of rural ratios of the village populations has already been discussed. The establishments housing the people contained in the other two groups are generally located in the more intensively farmed areas. The inclusion of the military personnel, predominantly male, tends to depress the ratio. The inclusion of persons in other institutions tends to raise the ratio, presuming that on an average the sex ratio in such institutions will be near 100.

The size of a further group, the suburban group commuting to the towns but living outside town boundaries, cannot be computed. It will have an urban-like ratio and the effect of its inclusion in the rural population will tend to raise the ratio. This may be illustrated by two individual examples. Waitotara County which on other evidence should have a low ratio in fact has a high one, 95.5, because its total population of 3516 includes approximately 1300 persons living in the suburbs of Wanganui City. The high ratio of Peninsula County is a result of the area being principally a suburb of Dunedin City. To a greater or lesser degree similar conditions exist around every sizable town in the country, and the effect of including these communities in the rural population is to raise the ratios, especially those of the lowland counties which are adjacent to urban settlements.

HISTORICAL CHANGES OF REGIONAL PATTERNS

Two further maps have been included so that the regional patterns of the sex ratio of the North Island might be compared historically (Figs. 5 and 6). They demonstrate what was expected, that, as the Dominion developed economically, transport improved, and isolation declined, so did the areas displaying ratios above the 1951 average rural sex ratio increase. The 1951 ratio of 88.5 was taken as a standard, and, for the years 1911 and 1936, areas whose sex ratios at that time were 5 or more below the 1951 ratio were plotted. In 1911 the Manawatu and southern Hawkes Bay stood out as areas with more balanced sex compositions. Similar areas were to be found adjacent to Auckland and New Plymouth.

By 1936 there had been some changes, but the pattern is not radically different. The sex composition had improved for most of Hawkes Bay, the Wairarapa, and Taranaki. The economic development of Northland about Whangarei and near Auckland was reflected, and so was the development in the Waikato around Hamilton. One may surmise that the spread of Auckland and its suburbs was also a factor of change, and that the rise in the Makara County ratio was a result of Wellington's growth. The intensification of land use about Gisborne and Tauranga may be picked out from the map. Between 1936 and 1951 the changes have been most marked. The effects of the de-

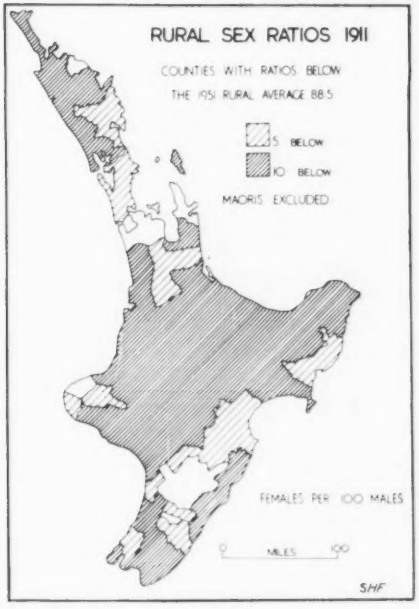

FIG. 5.

velopments in the Waikato, Northland, and Bay of Plenty are noticeable, and so is the fact that the areas with ratios 10 below the national average are considerably reduced. In 1901, 1911, and 1936 the majority of the towns, except those arising in pioneer areas, recorded sex ratios above 100, so that the femininity of the urban population has been characteristic for at least 50 years.

CONCLUSIONS

The regional analysis of the sex ratios supports the thesis from which this study originated: that differences exist between the ratios of the more intensively and less intensively farmed areas. It has also been shown that differences exist between the various urban areas in addition to the overall contrast between urban and rural districts. The analysis demonstrates that the sex ratio is an index of the socio-economic conditions prevailing in those areas. Differences between rural and urban areas are to be explained in terms of employment and the social attractions of city life; whereas the variations within rural areas are to be explained by patterns of farm employment, patterns of settlement, social disadvantages of rural life, degrees of accessibility, and the stage of economic development which makes for contrasts between long-settled and pioneer areas. Finally, the analysis has revealed that the low rural ratios are closely related to the migration of females, particularly of the ages 15–25 and over 65; and has drawn attention to further contrasts between the European and Maori populations within the Dominion.

The study entailed an inquiry into the nature and value of the sex ratio itself. To use the ratio alone without the additional information of age structure is to reduce its value as a tool.

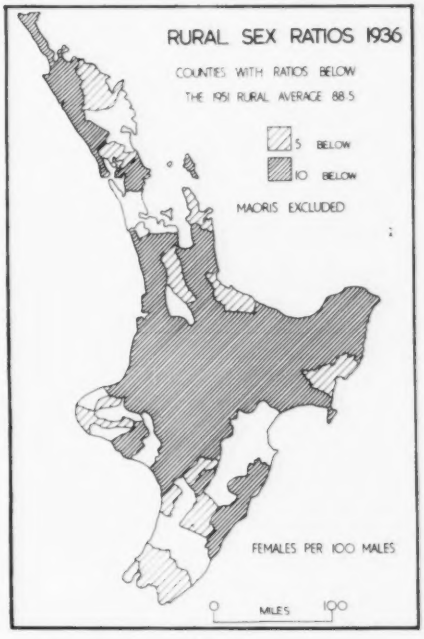

FIG. 6.

It is quite clear, however, that before age groupings may be used it is necessary to establish the correctness with which ages are stated at the census. Although it may be obvious that the ratio reflects socio-economic conditions, just what it reflects depends very much on the nature of the figures from which the ratio is computed. This was most apparent when dealing with rural ratios, for the rural figures as published included not only rural farm populations but a significant proportion of rural non-farm populations, a proportion which very much influences the interpretation. The historical development and ethnic composition of the population are also reflected by the ratio, and such factors as war, migration, and differing ethnic age structures need to be taken into account when the ratio is used.

The value of the sex ratio as a tool for analyzing a regional landscape cannot be denied. The ratio itself is a basic and important regional characteristic, and by plotting its regional variations much information can be gained concerning the regional geography of the Dominion. In interpreting the regional aspects of the ratio one is able to integrate a considerable amount of other regional information. It was not possible in this paper to combine the regional aspects of the ratio with regional age structures. But it is obvious that such a combination would be of value in any discussion of New Zealand. Age and sex ratios are significant to understanding the demographic character of a region, its patterns of consumption and demand, and its social characteristics and needs. It would seem that a regional demographic map using these factors, age structures and sex ratios, is as basic to the geographic study of New Zealand as are the more conventional regional maps based on physical and economic factors.

SUGAR REGIONS OF CUBA

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SUGAR and Cuba are synonomous in the thinking of many people. Although sugar is produced in many countries, both temperate and tropical, and is consumed in large quantities throughout the world, the most typical idea of its production is the vision of waving fields of sugar cane in tropical Cuba. Several geographic factors have favored the large-scale development of the Cuban sugar industry.[1] Tropical climate with a seasonal dry period that is necessary for high sugar content in the plant, productive soils, and large expanses of level to gently rolling topography combine to provide an excellent physical environment for sugar production in Cuba. Proximity to the great consuming markets of North America and relative closeness to the large markets of Europe, coupled with many good harbors close to the producing areas, also afford excellent natural advantages. Among the economic requisites that have fostered a high degree of specialization in sugar are the availability of large sums of American and other capital for investment in mills and transportation facilities, an ample supply of good labor, and favorable political relations, such as a tariff advantage in the United States market and a favored position in the United States sugar import quota system. Truly, sugar is king in Cuba; for, however sugar goes, so goes Cuba.

[1] Leví Marrero: *Geografía de Cuba*, La Habana, 1951, pp. 201–203.

Brief History of Production

The variable nature of sugar production in Cuba is reflected in the data on the quantity of sugar produced and the value received therefor (Fig. 1).[2] The amount of sugar produced increased steadily from less than one-half million tons in 1900 to four million tons in 1919, while the value varied irregularly from less than $50 million to $1 billion, the latter in 1920. Although production continued at a high level during the 1920's, with peaks in 1925 and 1929, the money received declined to $200 million in 1929, and dropped to a low of $40 million in 1932 as a result of continuously lowering prices. The effects of world depression were felt also in the amount of sugar produced when the tonnage dropped sharply from nearly 5 million tons in 1930 to 2 million tons in 1933. Both amount and value rose irregularly after the depth of the depression, and since World War II have exceeded the previous all-time highs, except for the peculiar peak income of 1920 after World War I when the average price f.o.b. in Cuba reached 12 cents per pound in contrast to previous and subsequent highs of 5 cents per pound.

[2] Source: *Anuario Azucarero de Cuba*, La Habana, 1936–, quoting Ministerio de Agricultura.

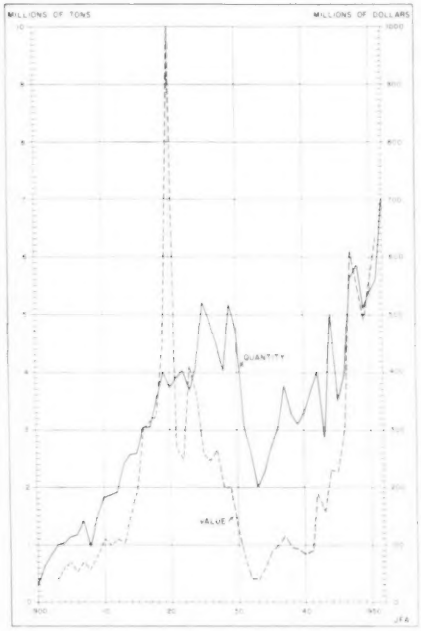

FIG. 1. Cuban sugar production, 1900–1952. Particularly evident are the increases following the two world wars and the slump following 1930.

Certainly, the wide variation in value received from the sugar crop has resulted in marked fluctuations in national income and prosperity.[3]

Since the process of producing sugar from cane is concerned with the rapid movement of the harvested cane to the grinding mills before it spoils, one can gain an understanding of sugar production within Cuba by an examination of the distribution and of the output of sugar grinding mills, or centrals. Generally speaking, the output of the mill is raw sugar, mostly for export to consuming countries where it is refined; roughly 10 per cent of the production presently is refined in Cuba. Some sugar is exported in the refined state, some molasses is exported, and some molasses is distilled into rum and aguardiente. About one-seventh of the mills have associated refineries, and there are several large refineries not associated with centrals.

[3] Ramiro Guerra y Sánchez: *La Industria Azucarera de Cuba*, La Habana, 1940.

TRENDS IN THE ESTABLISHMENT OF SUGAR MILLS

Within the past century, the trend in sugar milling, as in almost all phases of industry, has been toward fewer, larger, and more efficient mills. In the Cuba of 1860 there were reportedly 2000 small mills, in most cases family-owned with a large acreage surrounding each mill.[4] A large part of the explanation for decreasing numbers of mills lay in the casualties of civil war in Cuba. For example, after the 10-years war from 1868 to 1878, less than 1200 mills were left.[5] By 1899, after continued war and destruction, only 207 remained in such condition that they could operate satisfactorily. Shortly thereafter the first large mills were built on modern lines. More than 60 mills have been constructed during the present century, although none since 1927. A number of small mills have been dismantled since 1900, with the result that the actual number of operating mills has varied from a high of 199 in 1916–17 to a low of 125 in the depression year of 1933. The number of active mills has remained constant at 161 since 1946 (Fig. 2).[6] The total volume of sugar produced has corresponded in some degree to the ups and downs of the number of active mills, but some discrepancies appear, such as the large production during the early 1920's even when the number of active mills was steadily decreasing, a result of the ascendancy of the large centrals.

[4] Jacobo Pezuela: *Diccionario Geográfico, Estadístico, Histórico de la Isla de Cuba*, Madrid, 1863–66.

[5] Ramiro Guerra y Sánchez: *Azúcar y Población en las Antillas*, 3a. ed., La Habana, 1944, p. 73.

[6] Source: *Anuario Azucarero de Cuba*.

The history of the establishment of new sugar mills reflects the history of the entire industry in Cuba. A partial insight into such history is gained by an examination of the dates of founding of the presently-active mills. Although records are incomplete for some mills that were founded prior to 1902, a good picture of the regional distribution of mills is available (Fig. 3).[7] Particularly evident is the sugar heart of Cuba in the old sugar districts of Matanzas and Las Villas (formerly Santa Clara) provinces, where numerous closely-spaced old mills are situated. More than one-third of the active mills of Cuba lie in the "heart"; all but three in the area had been established before 1902. Other districts of old mills are (1) the wide belt of fertile Matanzas-type soils in southern Habana province, (2) the coastal plain southwest of Manzanillo in southeastern Cuba, and (3) the basin of Guantánamo in eastern Cuba.

The development of sugar mills since Independence has reflected the great economic activity along the eastern frontier in Cuba. Between 1905 and 1921 sixteen large, modern mills were set up in central and western Camaguey province in a former grazing area of large size. Other large mills have been established in the eastern part of the island, of which six are in eastern Camaguey and 24 in Oriente province. In sum, then, eastern Cuba has three-fourths of the new mills founded in the country.

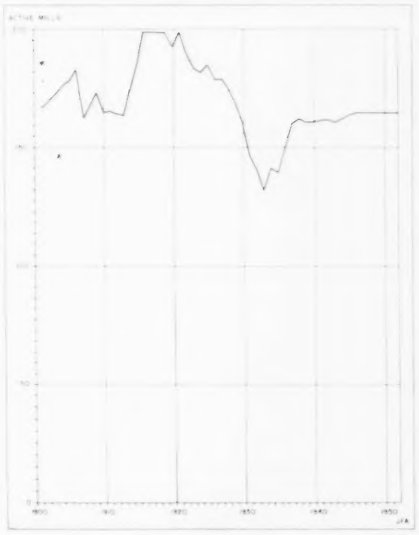

FIG. 2. Number of active sugar mills, 1901–1952. The number of active mills has varied irregularly from a high of 199 in 1916–17 and a low of 125 in 1933 to a constant number of 161 since 1946.

CRITERIA FOR DELIMITING SUGAR REGIONS

Although some semblance of regionalism appears in the record of dates of establishment of mills, other criteria must also be used in an endeavor to regionalize the sugar industry. Sizes of mills, whether large or small, are also distinguishing characteristics. Among the important spacial integrating factors is the sugar-exporting port, which focuses the production of several mills upon the dominantly export aspect of the industry. Because of the inherent problem of rapid transportation of the harvested cane to the grinding mill, the actual locations of individual mills are closely related to the fields that supply the cane. Types of soils constitute the decisive factor in the pattern of distribution for the cultivation of cane.[8] Almost all the cane areas correspond to areas of clay soils, of which the deep, red Matanzas clay is the most typical. About one-third of all cane produced is grown on Matanzas clay, particularly in the southern parts of Habana, Matanzas, and Las Villas provinces. Another relationship of sugar cane to the physical environment is that an estimated 68

[7] Source: *Anuario Azucarero de Cuba.*

[8] Leví Marrero, *op. cit.*, pp. 216–217.

FIG. 3. Sugar mills, year founded. The pattern of distribution of the presently-active mills in terms of their dates of founding graphically illustrates the contrast between the old sugar "heart" of west central Cuba and the newer mills of eastern Cuba.

Inset. Sugar regions. The 13 sugar regions, as used in this paper, are roughly outlined. Note that the Habana region also includes the sugar areas of Pinar del Río province.

per cent of sugar-producing fields are less than 100 meters above sea level and more than 99 per cent of the cane is cultivated in zones whose elevations are less than 300 meters above sea level.

Using a combination of criteria mentioned above, one can distinguish 13 fairly well-defined sugar regions in Cuba (Fig. 3, inset). Underlying the entire attempt to regionalize is the basic principle of spacial cohesion, i.e., the apparent concentration of mills in an area with a consequent open zone between concentrations. The regions are widespread, encompassing nearly all parts of the country except the rugged mountains of the southeast, such as the Sierra Maestra and Sierra Nipe, the large Zapata Swamp in extreme southern Matanzas province and southwestern Las Villas, the Isle of Pines, and the rugged limestone section of the west.

THE WESTERN REGIONS

The largest regions in areal extent, number of mills, and sugar production are the two western ones—Habana and Matanzas—with 22 and 24 mills respectively and more than $4\frac{1}{2}$ million sacks of sugar produced by each (Table I). It should be noted that these two regions encompass three of the six provinces of Cuba. The largest mill in western Cuba, Central Hershey in northeastern Habana province, was the twelfth largest producer in Cuba in the 1948–52 period, with nearly 600,000 sacks. The average production per mill, however, is relatively small for the two regions (Fig. 4). The smallest mill in Cuba, Central Elena in Matanzas province, produces less than 50,000 sacks yearly.

Nearly one-half of Cuba's sugar refineries are located in the two western

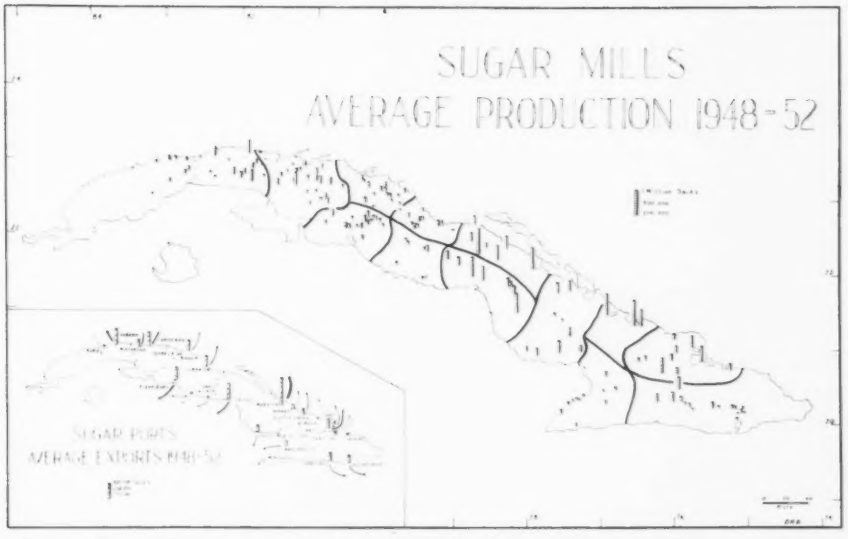

FIG. 4. Sugar mills, average production, 1948–1952. Contrasts in size of mills are evident in the small mills of west central Cuba and the large mills of eastern Cuba.

Inset. Sugar ports. Average exports for the years 1948–52 from the 23 principal ports are represented both by block piles and by flow lines. Every region except Northwestern Camaguey has at least one sugar-exporting port.

regions—eight in the Habana region and four in Matanzas. This includes the three refineries of Cuba not located at centrals—one in suburban Habana, the other two at Cárdenas. An illustration of the relationship between sugar mills and refineries is provided by the supply of raw sugar from Centrals Rosario, San Antonio, and Hershey to be refined at the large refinery at the site of Central Hershey. Hershey accounts for about one-third of all sugar refined in Cuba; most of this product is exported.[9] The second largest refinery is at Cárdenas, producing 15 per cent of Cuba's refined sugar. Most of the exported sugar, both raw and refined, of the westernmost region moves through Habana, second in Cuban sugar exports (Table II). A smaller amount is exported through Mariel in Pinar del Rio province (Fig. 4, inset). Exports from the Matanzas region are divided between the port of Matanzas and the nearby and more important port of Cárdenas, fourth in Cuban sugar exports. The two western regions account for one-fourth of the nation's sugar export.

[9] Cuba Económica y Financiera. *Anuario Azucarero de Cuba.*

THE CENTRAL REGIONS

The four regions of Las Villas province are about equal in average production per mill, being among the smallest as well as among the oldest in the country, but they differ in number of mills and in total production. All but seven of the 50 mills are now owned by Cuban companies; four are owned by American, three by Spanish companies. Southwestern Las Villas is a region of extreme concentration of a large number of small mills—16 in all—focused upon the large port of Cienfuegos, fifth in sugar ex-

TABLE I

CONTRASTS BETWEEN SUGAR REGIONS

Region	*Number of mills*	**Avg. production per mill*	**Total production avg. 1948–1952*	*Ownership*	*Refineries*
Habana	22	213,384	4,694,449	18 Cuban 4 U.S.	8
Matanzas	24	196,955	4,726,919	19 Cuban 3 U.S. 2 Spanish	4
SW Las Villas	16	188,470	3,015,519	12 Cuban 2 U.S. 2 Spanish	..
NW Las Villas	15	161,831	2,427,462	15 Cuban	4
NE Las Villas	12	156,210	1,874,519	11 Cuban 1 Spanish	1
SE Las Villas	7	144,222	1,009,551	5 Cuban 2 U.S.	1
SW Camaguey	9	473,172	4,258,550	2 Cuban 7 U.S.	3
NW Camaguey	7	584,953	4,094,673	3 Cuban 4 U.S.	..
E Camaguey	9	320,701	2,886,309	4 Cuban 5 U.S.	..
NW Oriente	3	879,070	2,637,209	3 U.S.	..
N Oriente	10	354,542	3,545,418	7 Cuban 3 U.S.	2
SW Oriente	11	143,306	1,576,366	11 Cuban	2
S Oriente	16	198,426	3,174,820	7 Cuban 7 U.S. 1 Spanish 1 French	1
Total (or Average)	161	247,961	39,921,764	114 Cuban 40 U.S. 6 Spanish 1 French	26

*Production in terms of sacks of 325 Spanish lbs., or 329.6 English lbs.
Sources: Anuario Azucarero de Cuba (1948–1953); Instituto Cubano de Establización del Azúcar.

ports. Northwestern Las Villas has 15 small mills, all Cuban-owned, but the total production is somewhat less than that of the southwestern region; export is through the port of Isabela la Sagua. Northeastern Las Villas is a region of 12 small mills heavily concentrated around the port of Caibarién; its total production is very small—less than 2 million sacks. The seven small mills of the hilly Southeastern Las Villas region account for the smallest production of any region of Cuba—only 1 million sacks. Exports are moved through two small ports, the old port of Casilda at the southern edge of the somewhat rugged Trinidad Mountains and the port of Tunas de Zaza, some 30 miles eastward.

THE EASTERN REGIONS

The three regions of Camaguey province have typically large, modern mills with wide spacing between most mills. In northwestern Camaguey, Central Morón had the highest average annual production between 1948 and 1952, averaging just over 1 million sacks. In contrast to the regions of Las Villas, the majority of mills are owned by American companies. American-owned mills number 16, Cuban-owned, 9. The string of nine mills in Southwestern Camaguey region average nearly one-half million bags each, and the total production of more than 4 million bags make it the fourth region in production. In spite of the fact that the port of the region, Júcaro, is shallow, and large

TABLE II

SUGAR EXPORTS BY REGIONS

Port	*Region*	**Average export 1948–1952*	*Percentage of total*
Mariel	Habana	705,831	2.0
Habana	Habana	3,421,248	9.7
Matanzas	Matanzas	1,512,238	4.2
Cárdenas	Matanzas	2,896,938	8.2
Isabela de Sagua	NW Las Villas	2,166,298	6.1
Caibarién	NE Las Villas	2,114,834	6.0
Nuevitas	E Camaguey	5,061,946	14.2
Manatí	NW Oriente	822,443	2.3
Puerto Padre	NW Oriente	1,588,244	4.5
Gibara	N Oriente	222,811	.6
Banes	N Oriente	451,779	1.2
Antilla	N Oriente	1,728,453	4.9
Preston	N Oriente	604,137	1.7
Tánamo	N Oriente	252,739	.7
Guantánamo	S Oriente	1,332,371	3.7
Santiago de Cuba	S Oriente	1,624,490	4.5
Niquero	SW Oriente	174,231	.5
Manzanillo	SW Oriente	934,437	2.6
Santa Cruz del Sur	E Camaguey	1,334,544	3.8
Júcaro	SW Camaguey	3,055,797	8.6
Tunas de Zaza	SE Las Villas	547,816	1.5
Casilda	SE Las Villas	289,648	.8
Cienfuegos	SW Las Villas	2,666,878	7.5
Total	.....	35,473,750	.....

*Exports in terms of sacks of 325 Spanish lbs.

ships must anchor offshore, it is the third largest exporter of sugar in Cuba. More than 4 million bags are also produced in Northwestern Camaguey, but from only seven mills. Therefore, the average production per mill is nearly 600,000 bags, the second highest average in the country, and, coincidentally, almost exactly the same as the output of the *largest* mill of western Cuba, Central Hershey. No good port occurs in the region; consequently, sugar is exported through Nuevitas on the northeast coast of Camaguey. Nuevitas, which also exports most of the sugar from the Eastern Camaguey region, is the largest sugar-exporting port in Cuba, accounting for nearly 15 per cent of the total for the country in contrast to slightly less than 10 per cent for Habana, the second sugar port. Eastern Camaguey is characterized by scattered mills of various sizes from small to moderately large.

The four regions of Oriente province present a diverse picture of ownership, size, and pattern of distribution. Of the 40 mills in the province, 25 are owned by Cuban companies, 13 by American, and one each by Spanish and French companies. Northwestern Oriente is unique in having by far the highest average production per mill—nearly 900,000 sacks. Three giant mills, all American-owned and located close to the embayed north coast, account for all of the large total production. The largest of the three, Central Delicias, had an average annual output for the period 1948–52 only slightly less than Central Morón, making it second in Cuba. Export is through two ports, Manatí and Puerto Padre. Northern Oriente also has a number of large mills among the 10, and its average production per mill of more than 300,000 sacks is well above the national average. The mills are widely spaced and export is through five separate ports—Gibara, Banes, Antilla, Preston, and Sagua de

Tánamo. All of the 11 mills in Southwestern Oriente region fall below the national average in production, giving the region the smallest average production in the country. Total production is next to the lowest in the nation. The smallest mills are strung along the coast southwest of Manzanillo, whereas the larger mills are situated a short distance inland in the large, alluvial plain of the Río Cauto. All are Cuban-owned. The Southern Oriente region consists of 16 small to moderately large mills located in the basin of Guantánamo and the Central Valley westward to the upper Cauto. Total production of the region and average production of mills are moderate. Ownership is diverse, seven being Cuban, seven American, one Spanish, and one French. Exports move through the ports of Santiago and Guantánamo.

DIVERSITY OF REGIONS

Among the 13 sugar regions of Cuba, great diversity exists in the number, newness, size, and ownership of mills and in average and total production. The Matanzas region has the largest number of mills, with 24; Northwestern Oriente the fewest, with three. The Habana and Eastern Camaguey regions have the newest mills, and Habana the oldest still in operation. Northwestern Camaguey and Northwestern Oriente have the largest mills, Matanzas and Northwestern Las Villas the smallest. The highest average production per mill occurs in Northwestern Oriente, the lowest in Southwestern Oriente and Southeastern Las Villas. The highest total production is in the Matanzas and Habana regions, the smallest in Southeastern Las Villas. In general, the central regions have the oldest, smallest, and largest number of mills, as well as the lowest production in total and average per mill; whereas the eastern regions have the newest, largest, and smallest number of mills and the highest total and average production. The western region, Habana, lies between the two extremes in most characteristics.

BOOK REVIEWS

La Ville: Le Fait Urbain a Travers Le Monde, by PIERRE GEORGE. viii and 399 pp.; maps, ills., bibliogr., index. Presses Universitaires de France, Paris, 1952. 1400 fr. 10 x 6½ inches.

The possibility that urban geography may soon come of age as a scientific discipline is indicated by the appearance of a series of important texts during the past several years. In the latest of these, Professor George manages to touch on all phases of his subject—theory and fact, morphology and function, the world-wide and the regional aspects of cities, their history and dynamics, and, above all, their social, demographic, and economic implications mainly through the device of a tour through a selected group of urban centers. After opening the volume with a brief essay on the quantitative significance of cities in the modern world and on the uneven extent of urbanization among individual countries, George succinctly sketches the major methodological problems confronting the urban geographer. His provocative remarks on such items as urban "physiognomy," the definition and classification of cities, and the relationships between city and hinterland are valuable; but these introductory chapters do more to deepen the reader's craving for some definitive theory than to satisfy it.

The bulk of *La Ville* consists of a three-part description of the urban geography of the major regions of the world. Since Europe is the homeland of the type of urbanism now dominant virtually everywhere, the genesis and characteristics of its cities are accorded extended treatment, both on a continental and a national scale. George's technique in handling an individual country is to characterize the texture and quality of its urban network in a few bold strokes and then to analyze its metropolis in some depth, along with a few representative cities of moderate size. This program is most fully executed in the cases of France and Great Britain, while Germany, Belgium, and other lands are given rather short shrift. The second group of regional chapters takes in "the urban consequences of European expansion" as represented in the Americas and in the colonial regions of Africa and Asia. American readers will gain precious insight into the nature of their cities from George's fresh and incisive descriptions of our urban culture in general and the cities of New York, Chicago, and Montreal in particular. Of even greater value, however, are the accounts of the urban geography of North Africa, Tropical Africa, and Southwest Asia, since this is the first serious attempt to deal with the topic in these relatively neglected regions. The concluding section is devoted to the cities of the U.S.S.R. and Eastern Europe, where much that is unfamiliar and interesting is brought to light, especially in the treatment of Moscow and Warsaw. Although George believes urban evolution to have reached its culmination in the Soviet realm, it is not too clear from the evidence offered whether these socialized cities have diverged far enough as yet from those of other areas to merit separate classification.

In many respects George's work represents an advance over that of his predecessors; but even though he has essayed only a sort of travelogue account of the urbanization of the world, he has not fully succeeded in his limited task. First of all, there are serious gaps in his regional coverage: the Latin American section is so perfunctory it might have been wiser to have eliminated it altogether; the materials on South and East Asia are only slightly better; and nothing at all has been done with the cities of South Africa, Australia, and New Zealand. The raw materials for an exhaustive regional urban geography of the world are now abundantly available, but decades would be required for their assimilation by one writer: George has elected instead to do a sampling type of reconnaissance. What we have, then, is a series of well-written, often brilliant vignettes of some important cities, with the total effect being somewhat improvisatory. Whatever its shortcomings, however, this book is a unique compilation and well worth the student's attention for many years to come.

Perhaps more serious than the thin spots in regional treatment are George's complete avoidance of the smaller city (except for one French example) and the lack of any material on the spatial and functional interrelations among cities of various ranks in the urban hierarchy or between city and hinterland. What the author does do exceedingly well is to show the interweaving of geographic fact and socio-economic principle in relating the history and internal structure of individual places, his major contribution being a deft bridging of the gap between urban sociology and urban geography. In fact, the geographic purist may mutter that George has actually written a sociological tract with only occasional asides on the spatial aspects of cities. If there is any dominant theme in this work, it stems from the author's close interest in socio-economic theory—the city as the gauge and complex embodiment of the uneven economic development of the regions of the world, from relatively primitive farming

and mercantile societies upward through capitalism and socialism in all their subphases.

However valid his theoretical work may be, it is fragmentary, and George has failed to produce a complete theory of urban geography. Thus, *La Ville* emerges as a stimulating, highly readable survey of some important, but not thoroughly integrated ideas about cities and a collection of penetrating essays on about a score of metropolises, which amount to illustrations of these partially formulated principles. It would seem that the time is ripe for someone to step forward and develop these principles more fully into the rich, coherent body of theory that is now within reach. Unfortunately, it will be a backbreaking job, and there is not likely to be a stampede of scholars rushing to fill the breach.

In closing, a word of praise is due the maps and the excellent bibliographies following each block of chapters.

WILBUR ZELINSKY

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The Trade of Lake Victoria, by V. C. R. FORD, East African Studies No. 3. iv and 66 pp.; maps, ills., tables, bibliog. East African Literature Bureau, Nairobi, 1955. 11s. $9\frac{1}{2}$ x 6 inches.

This monograph is an example of the detailed explanatory descriptions, resting on statistical and field evidence, that have been prepared in very recent years by geographers who have lived or worked in Africa long enough to become conversant with the whole regional fabric they study. The author, from his vantage of several years on the staff of Makerere College in Uganda, has observed the lake traffic, traced its history to the beginnings, digested the statistics, and tied all these facts into the character of the lake and of the varied lands that surround it.

The presentation rests on maps of the lake trade. Seven of them spot the tonnage by ports at approximately six-year intervals from 1914 to 1952; eight depict both the port tonnage and the traffic flow of the leading commodities in 1952; two do the same for dhow transport in 1938 and 1951; and one is a place map. This last comes in for heavy duty, because of the many names unfamiliar even to those who have worked in the area. (Two or three places mentioned in the text do not appear on the map.)

The source of nearly all the lake trade is the regional variety in production of the lands along and behind the lake shore. These tributary regions are diversified by rainfall, elevation and drainage, soil, water supply, natural vegetation, tsetse fly, land occupance, and local tribal tradition. They reach landward a varying distance—some 30 or 40 miles.

The lake region as a whole is characterized as to surface configuration, climate, and vegetation; then six regional divisions are distinguished, named, and their differences briefly presented. The author makes it clear that statistics do not permit a quantitative exposition of the trade by regions, but this reviewer would have profited by restatement in the subsequent chapters of the particular regional aspects significantly associated with the historical periods into which the trade falls, and with each major commodity that enters into the trade today.

Lake traffic began with the entrance of outsiders—Arabs and Europeans. At the outset the Europeans divided the lake region among three political units, whose regulations affected the traffic until 1948, when unified control over transport, customs, and fisheries was set up. The author believes that "Lake Victoria with its marginal lands can look forward to a new period during which its potentialities as an economic and geographic unit may for the first time be fully developed" (p. 64).

However that may be, unalterable modifications of the volume and the items of lake trade were brought about by construction of railways and of lake ships operated by the railways. The rails bypassed some ports and diverted much traffic from lake routes; the ships altered the direction of waterborne trade. Being government agencies, the railways have been protected by regulations that reduced competition from private lake carriers.

Photographs visualize the boats that carry most of the traffic. Pictures of port installations and significant shorelines would further help the reader to grasp the scope and variety of the commerce.

DERWENT WHITTLESEY

Harvard University

Virginia at Mid-Century, by JEAN GOTTMANN. viii and 584 pp.; maps, ills., index. Henry Holt and Company, New York, 1955. $7.50. $9\frac{1}{2}$ x 6 inches.

This beautifully illustrated volume is indeed the portrait of Virginia, itself a work of art, "created over a long period of time by the cooperation of many people, past and present, among themselves and with many physical and economic factors beyond easy control." The eastern Tidewater and the western "Valleys and Ridges" section—the physical stage—are described in detail, in order the better to analyze the activities of the actors in space and in time, locally and internationally. The chapters, "Three and a Half Centuries of Change" and "Regional Divisions and Modes of Life" are examples of the highest order of writing on historical geography. They trace the evolution of that fondness for the local past and that desire to make it live on into the present that became integral parts of Virginia's tradition. It is seen why very early Virginia became the

natural leader of the Southern rural areas against the mercantile, financial, and capitalistic interests of the rest of the nation.

The heart of the volume treats of the physical resources—farmland, forests, and minerals—their use and misuse. It is particularly pertinent to point out that "there is no optimum size for farms, given a certain soil and a certain climate." Those who feel that the panacea for agrarian problems everywhere is the creation of small owner-operated landholdings should be sobered by reading the conclusion that "Virginia could still achieve great progress by accelerating the pace at which the small subsistence or too-specialized farms are receding today. The advances scored in the last 20 years by the larger farms, growing in number and in area, must be considered a healthy and desirable trend." The old concept of a plantation as a large rural estate with impressive looking residential quarters for the owner and with abundant manpower has been greatly modified, for the mechanization of agricultural work has reached the point where a few men, adequately equipped, can manage a vast acreage of cropland and pasture. Indeed, present-day plantations more often than not grow trees and raise cattle rather than the traditional cotton or tobacco.

Resistance to change is a popular attitude among Virginians, and could be expected to show itself on the issue of desegregation. However, as urbanization and industrialization come to a majority of the population, as newcomers are added to the society, as more education is available to the average individual, the emphasis will more and more be on gradualism. The earth does move, and so does the Old Dominion. It is not so much a question of change, but of how much and how fast. Indeed, in their efforts for self-preservation, human societies everywhere seem to have a way of shifting their emphases and orientations, as they endeavor gradually to reshape themselves. This is especially true in the case of desegregation, as the author points out, and, although subterfuges and filibustering will be resorted to in order to postpone desegregation, it is inevitable that societal readjustments will be effected whereby the *de jure* and the *de facto* situations will be more nearly synonymous than they are today.

This is a significant regional monograph on one of the great states of the Union. The Old Dominion Foundation under the leadership of its founder, Mr. Paul Mellon, a man of great insight and broad vision, has shown the way. May leaders in other states take notice, and continue to make support available for this kind of regional analysis and interpretation. Professor Gottman is generous in his acknowledgments, especially to Professor Edward C. Higbee of Clark University whose interpretations were most helpful to him.

RAYMOND E. CRIST

University of Florida

Southwest Pacific, by K. B. CUMBERLAND. xviii and 365 pp.; maps, plates, glossary, index. Whitcomb and Toombs, Christchurch, N.Z., 1954. 19s.6d. $8\frac{3}{4}$ x $5\frac{1}{2}$ inches.

In many ways this is an attractive book. Clear printing and a wealth of really excellent and well-annotated photographs contribute to a pleasing first impression, and beyond this Professor Cumberland writes with lucidity well adapted to the level on which he is working—for senior school and junior university classes, and for a general public. A few minor flaws of grammar are offset by some felicitous phrasing: for example, "thousands of coral islets . . . lost over its blue expanse like a handful of confetti scattered over a lake" (p. 5). On a more sustained scale it would be hard to better the "model" of colonial industry (including that standard feature, "the printing of newspapers in which to criticise the government of the day") on p. 223. But against these credits must be placed some serious debits.

The book opens with two adequate chapters (pp. 1–49) on "The Setting" and "The People"; to American readers, recalling David Porter's base in the Marquesas (1813) and a host of Yankee whalers, it may seem narrowly legalistic to assert (p. 36) that, apart from Alaska, "the United States did not enter the Pacific until the turn of the century"; but indeed history is not Professor Cumberland's strongest point. There follow two paired chapters on Australia (pp. 50–126) and New Zealand (pp. 175–249) and the "Pacific Island Neighbourhood" of each. The book ends with a brief and not very stimulating "Prospect and Retrospect."

The chapter on New Zealand—the author's home ground—is by far the strongest, that on Australia so weak that if on joint account there is a credit balance, the Australian section is definitely in the red. There are also some general defects. Most of the maps are clear and informative, though on some the line-work is poor: on Figure 53, for example, the coconut plantations look more like reefs. But of the 93 maps only 27 have scales (nine of which are wrongly set out) and only *five* have any indication of latitude or longitude: this in the Pacific, where precise locational reference is perhaps more important than in any other part of the globe. The climax of carelessness is reached in Figure 87 (Fiji), where grid intersects are shown—one for a detached inset—without any figures. Of the 21 general maps of Australia, not one is scaled, though on one Tasmania is drawn at least twice the main scale. Of the 21 general maps of New Zealand, two only have scales, these being the two which least need them. It might be pedantry—though a salutary pedantry—to insist on grids and scales to all maps, but surely climate demands an indication of latitude, transport of distance.

It is regrettable that some maps call for another comment. In his preface Professor Cumberland remarks airily that "The material used in the book has been drawn from innumerable sources. It would be a major task and would take too much space to acknowledge them all." But surely this does not absolve him from the duty of a general acknowledgment of *some*, the most important at least; still less excusable is the absence of all reference to the originals of maps taken from published sources with the barest minimum of adaptation. To Australian geographers Figures 25, 27, 29, 33, 37, 39, 40, 45, 50, and 51 will seem all too familiar. Figures 39 and 40, for example, are simply translations from color into black-and-white of two maps in Professor Macdonald Holmes's *The Murray Valley*, the only alteration of the slightest moment being the omission of the scale! The excuse of want of space is mere trifling: there is ample room on the face of the map itself for the bare courtesy of two words—"after Holmes."

To return to the text, there seems little to criticize in the New Zealand chapter, except perhaps a tendency to take local knowledge a little too much for granted; though Figures 62 and 63 seem inconsistent with each other and the text. Both here and in the chapters on the "Pacific Neighbourhood" there is much useful information interestingly presented; criticisms on emphasis would not amount to much. It is of course difficult to maintain reasonable proportions in dealing with so many scattered and disparate units, though even so one may feel that "a geography conceived in simple terms as the study of 'what places are like'" (the last words of the text) might give more than $5\frac{1}{2}$ lines of mere generality to cover both Sydney and Melbourne, and less than $2\frac{1}{2}$ pages to the 2500 acres and 1600-odd people of the Tokelau Islands. But this reflects the general poverty of Professor Cumberland's treatment of Australia.

His gift for easy description and clear discussion does not desert him here, and the Australian section has some good pages. But misleading emphasis and plain error are rather too common for comfort. It is not true that the aborigines found not one species of the indigenous flora and fauna suitable for use as food (p. 50); they did not after all live on rock and air. The account of early settlement (p. 52) is quite wrong, as is the South Australian section of Figure 19 (structure). There is no reference at all to the very lively and interesting question of "air beef," while both map and text on dairying (p. 83) are at least rather questionable. The omission of all reference to open-cut coal working in the Hunter is more serious: Figure 44 is definitely misleading and the text does nothing to mend matters. Displaced and refugee persons do not form most of the post-war immigration (p. 123). Anyone who ranks domestic service, including that in hotels, as amongst those services more fully provided in Australia than in any other country (p. 115) can have but a very passing, and lucky, acquaintance with the facts of life in the continent.

Such details apart, a good deal of the discussion of Australian problems seems rather in the air. It is significant that not one of the maps of Australia shows a state boundary; there are two mere passing references to federation, but nowhere any mention of the states as entities. I do not think that Australian development can be understood, on any level beyond primary school, without some discussion of this fundamental matter.

There remains a great deal of good material in this book. To confine it to New Zealand and her "Pacific Neighbourhood" would be stultifying: there is real need for a good concise account, well illustrated as this book is, of the Southwest Pacific as a whole, and one written from an Australian viewpoint. With a complete recasting of the Australian section *Southwest Pacific* could fill the gap. And, please, some credits to fellow-workers.

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NEW EDITIONS

An Intermediate Commercial Geography, Part II, The Economic Geography of the Leading Countries, by L. DUDLEY STAMP. 8th edit., rewritten. 584 pp.; maps, diagrs., tables, index. Longmans, Green and Co., Inc., New York, 1955. $5.00. $8\frac{1}{2} \times 5\frac{1}{2}$ inches.

Economic Geography, by SAMUEL NEWTON DICKEN. (A successor to *A Regional Economic Geography*, published in 1949.) xii and 569 pp.; maps, diagrs., tables, ills., index. D. C. Heath and Company, New York, 1955. $6.50. $10\frac{3}{4} \times 7\frac{1}{2}$ inches.

Industrial and Commercial Geography, by J. RUSSELL SMITH, M. OGDEN PHILLIPS, and THOMAS R. SMITH. 4th edit. xiii and 689 pp.; maps, diagrs., tables, ills., index. Henry Holt and Company, New York, 1955. $6.95. 10 x 7 inches.

Regional Geography of Anglo-America, by C. LANGDON WHITE and EDWIN J. FOSCUE. 2d edit. xxiii and 518 pp.; maps, diagrs., tables, ills., index. Prentice-Hall, Inc., New York, 1954. $7.50. 10 x 7 inches.

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